EDITORIAL

DURING last month we read two news items which I think are particularly important.

The first was the decision of the British Government to discontinue production of fighter aircraft. The second, that Russian bases in the Antarctic, primarily for use during the geophysical year, may become permanent military depots.

Barely fifteen years ago Britain was saved from destruction by fighter aircraft with a speed of about 400 mph. The latest fighter it is proposed to take into service has an undisclosed speed hardly less than 1000 mph.

But Britain realises that any future assault on her shores will not come from clouds of bombers which can be shot out of the sky. The attack she must face will be the long-range rocket projectile, travelling too far and too fast to be intercepted by any manned fighter.

The V-2 rockets which wreaked such havoc in the closing stages of the last war were an object lesson. They were the forerunners of the new and deadly warfare in which some day she might be involved.

The blueprints of such missiles are already contained in the details of those we have been told about. A picture of one such missile taking off in a curtain of smoke and flame will be found in this issue.

Whatever may be the counter to mass rocket attack, it is not the fighter plane. A rocket may have completed enough of its trajectory in mere minutes to ensure success wherever it falls. The portion of its arc through which effective intercept can be made seems desperately small. Reaction and reply to an assault must be almost instantaneous to be effective.

The consequences of concentrated rocket attack would be so great that its mere threat may be the real weapon for some time to come. No one will gain from complete devastation. This could well happen if the only answer to an attack is an equal counter-attack before the first bombs have struck.

The growing importance of Australia's rocket range has turned military attention to our shores. So far we have been geographically less vulnerable than other parts of the world. But possible rocket bases in the Antarctic materially alter our position.

The decline of the fighter plane and the establishment of such bases go hand in hand.

That is why these news items call for deep thought.

John Moyle

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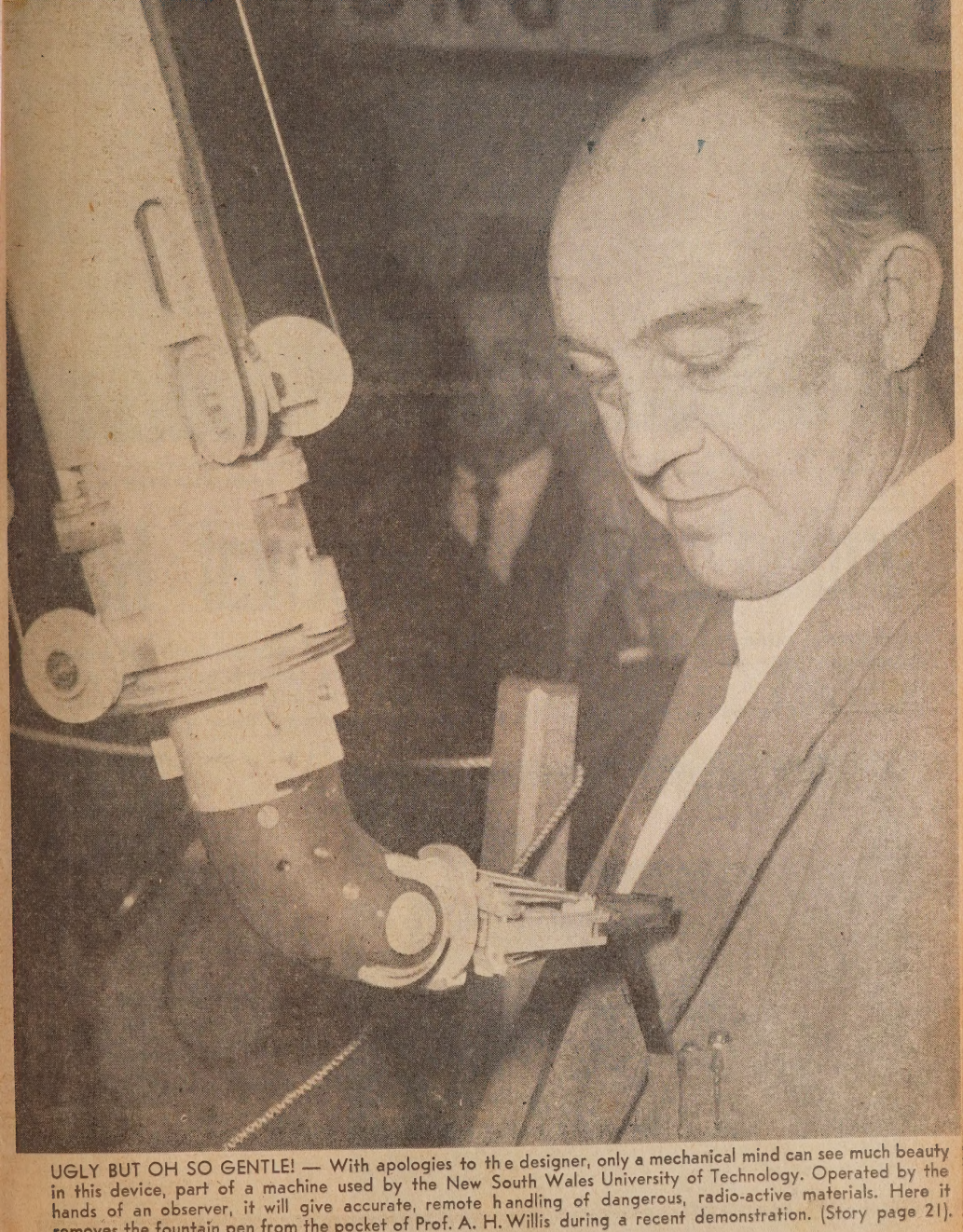
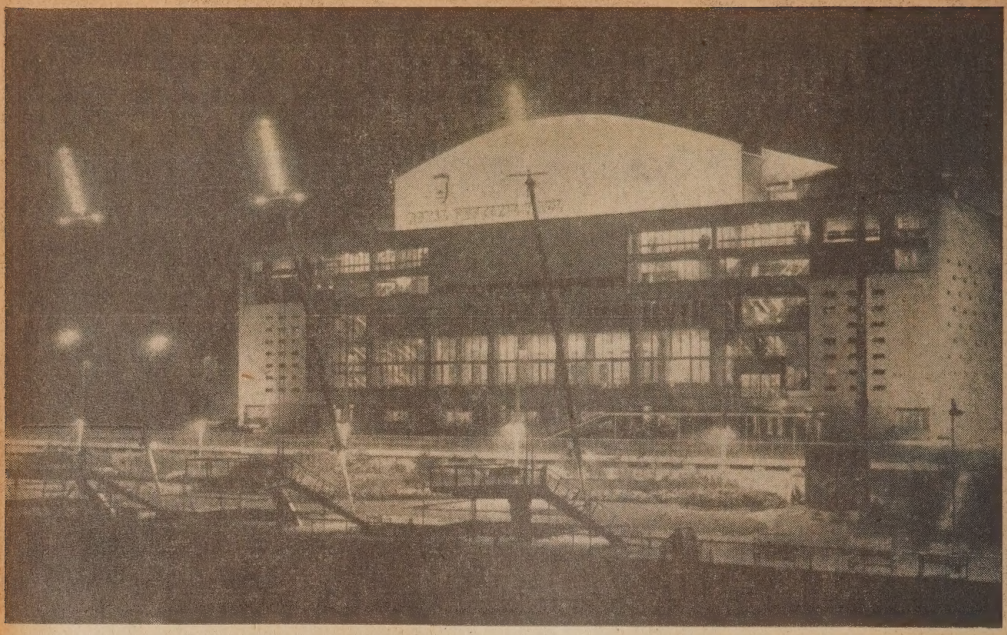


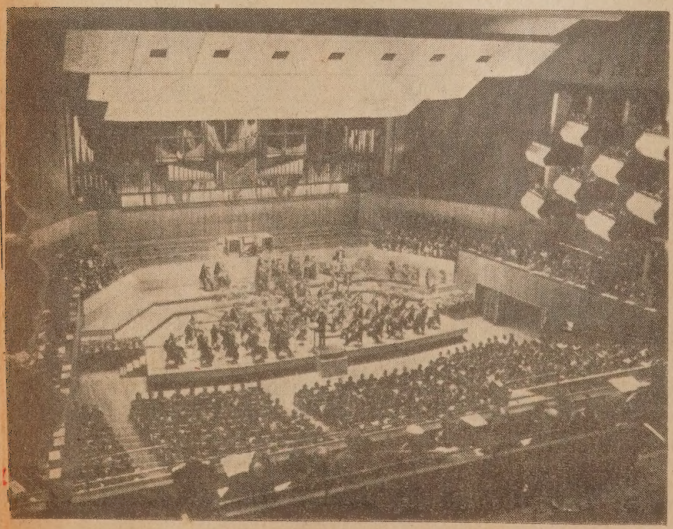
UGLY BUT OH SO GENTLE! — With apologies to the designer, only a mechanical mind can see much beauty in this device, part of a machine used by the New South Wales University of Technology. Operated by the hands of an observer, it will give accurate, remote handling of dangerous, radio-active materials. Here it removes the fountain pen from the pocket of Prof. A. H. Willis during a recent demonstration. (Story page 21).



The Royal Festival Hall viewed from the River Thames. Behind the lighted windows are the restaurant and buffet—gardens and promenade at ground level. Above is the floodlit rear of the auditorium. Some internal stairways and pillars are visible.

London's Royal Festival Hall

The proposed design for Sydney's new Opera House has excited very great interest among the general public, as well it might. Heated w ords and strong opinions have filled many pages in the daily papers, but practically all of them have dealt with external appearances. Little or nothing has yet been said about the all important question, "How will it sound?"



This view from the balcony shows orchestra positioning, the reflector above, avoidence of parallel surfaces, wall treatment, organ layout and lighting.

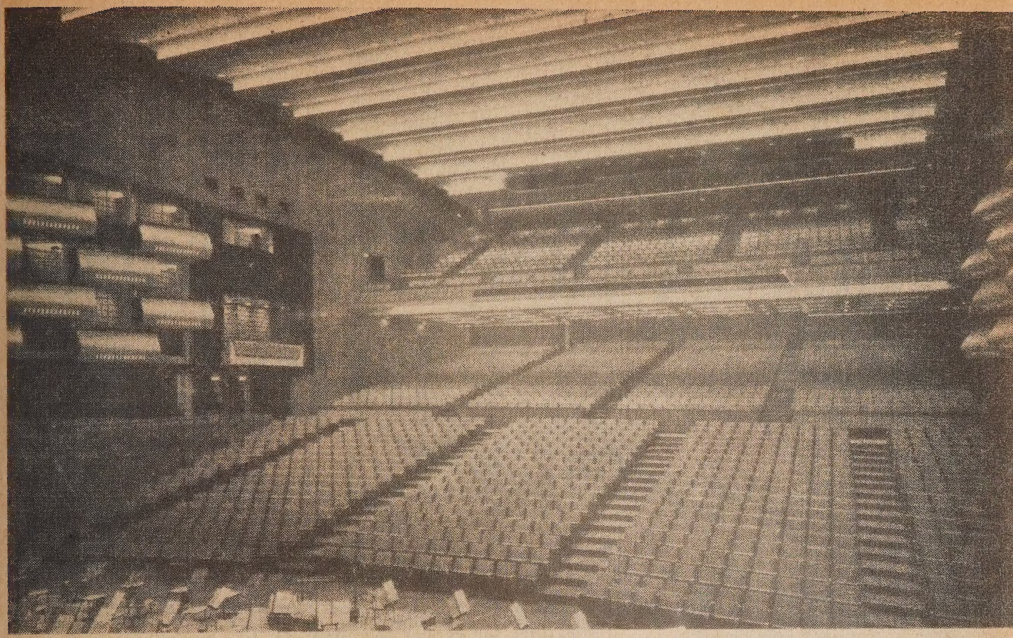
AND yet this is the most important question of all, for unless we are given acoustic qualities second to none in the world, we will have wasted our money.

Most musical people would gladly make any sacrifice in outside appearances to be freed once and for all from the poor listening conditions we have endured for so long. During recent years great progress has been made by acoustical engineers toward an understanding of concert hall technique, and there is no excuse for us to be satisfied with anything but the very best.

OPERA REQUIREMENTS

There are still many points of disagreement about the ideal concert hall, but many broad principles are beyond argument.

It is difficult to understand why the term "opera house" should so consistently be applied to the new project, for designing a hall which can be used for orchestral concerts, and undoubtedly this



Looking towards the rear of the hall from the organ. Note the rising tiers of seats, absence of rear reflecting surfaces, sectionalised ceiling, sound treated side walls well broken up by "boxes". Small black holes in ceiling were to have been fitted with resonators.

must be a first consideration, does not mean acoustics suitable for opera.

A combination of crystal clear diction and a close view of the stage are virtually impossible to provide in a concert hall, particularly one which has no balcony and which must seat up to 3000 people.

Just as impossible is it to design a hall in which a grand organ will sound like the organs as we know them.

It is of paramount importance that, when building a hall, those responsible have the clearest idea of what they are about. Otherwise they will inevitably produce something which, in attempting to do all, does nothing well.

ORGAN TONE

That won't be much consolation to the citizens who will have to use it for very many years to come.

Precisely the same problems confronted the designers of the Royal Festival Hall in London, which is now regarded as the finest concert hall in the world.

It is not ideal for opera, and would not be considered against Covent Garden Opera House, for instance, where there is less reverberation and a high concentration of seats comparatively near to the stage. The very presence of a large proscenium and deep stage removes one of the prime requisites for a concert hall—an efficient reflecting surface behind the players to project the sound forward to the audience by carefully calculated paths.

Similarly a big organ pleases most people in a hall when there is a very long time constant of reverberation to build up the tone and allow the organ to sound as big as it is.

There is no more controversial feature about the Festival Hall than its magnificent organ. It is crisp, clean, and with a wonderful power of definition, but no one could imagine it has anything remotely resembling a cathedral quality.

Listening to it, one has to completely revise his ideas of how a big organ can sound.

But for orchestral concerts, possibly the only type of musical entertainment which these days can pay its way, it is, in my opinion, second to none.

It has become the centre of musical life in England, and has exerted the greatest possible influence on music, even on the Continent.

It has done more to lift the standard of performance in recent years than anything else, for no blemish can be ignored where there is no woolly acoustical fog to cover up bad workmanship, and provoke bad habits among the players and conductors.

by The Editor

A concert hall of this type in Australia will convince discriminating listeners that for the first time they are able to judge just how fine an orchestral performance can be.

BALANCED LISTENING

It will demonstrate that the unrivalled clarity and balance which distinguishes modern recordings can be approached at a concert, with the addition of all those extra attractions which divide the live performance from its reproduction in the home.

So much thought and planning went into the Festival Hall that small books have been written about it. It has all the amenities which the new Sydney project includes—spacious foyers and entrance hall, restaurant and buffet which allow concertgoers to make their outing a planned and relaxing event, a great glassed outlook across the river Thames, adequate and sympathetic booking facilities, places to park your car and take your ease.

It is not an attractive building by ultra-modern standards, but it has the cardinal virtue of being built essentially as a superb auditorium, with no compromises to interfere with that main objective.

DOUBLE INSULATION

The available site suffered badly in being so close to the Charing Cross railway bridge, over which noisy trains pass day and night.

To avoid the inevitable noises which otherwise would have ruined any performance, the auditorium was built as a complete unit, mounted on a number of pillars which went deep in the earth.

These prevented most of the vibration being transferred to the hall by reducing its supports to the fewest possible insulated points. This was no mean engineering feat, as the hall itself weighs 25,000 tons.

The remainder of the structure is built around the hall, whose walls are of double section concrete with an air space between, but has very little contact with it.

Even at the doorways there are covered gaps in the floor to ensure this.

The roof is also of double concrete section. The air space is filled with glass silk insulation, which also surrounds the columns which they are used to support the lower part of the building.

The outer section of the building is supported on additional columns exc

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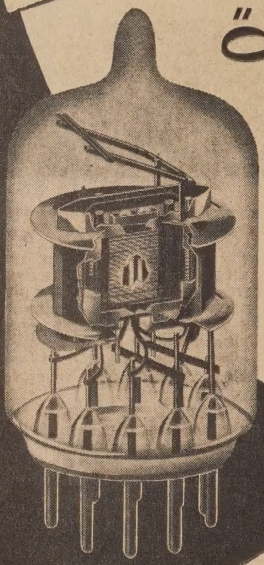

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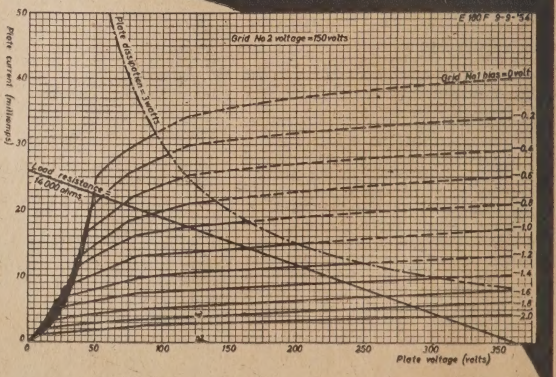

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at the corners, where the staircases are used to buttress it. It forms a huge insulating shell around the hall itself.

Even in the foyers it is almost impossible to hear the rattle of steam trains as they rush across the bridge in plain sight. In the auditorium, the normal residual noise is higher than that from any outside source.

Great care was taken over the most important acoustic features. Echoes caused by sound waves bouncing from the rear wall back to the stage to ruin definition were avoided, a sloping floor or "rise" was included so that direct sound waves would reach every seat, and reverberation or second-order sound waves which bounce from the walls and roof to give color and life to the performance were studied and controlled.

Echo was avoided by providing a solid mass of specially-constructed seats which face the stage almost to the roof. What there is left of the rear wall is covered with red padded leather which effectively absorbs the sound.

The seats are designed to have the same absorption co-efficient as the human body, so that, empty or full, the acoustics are virtually the same.

BROKEN SURFACES

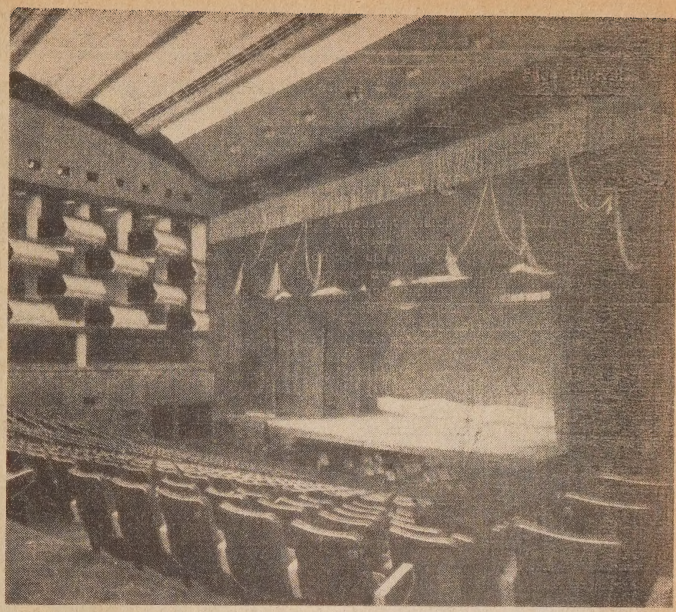
The side walls are broken up by tiers of "boxes" which have been likened to a series of desk drawers in an open condition, by further treatment with padded leather, and by the use of acoustic panels to obtain the desired reflection and absorption of various frequency bands.

The bass notes are absorbed where required by panels which can vibrate at these frequencies. Polished surfaces allow reflection of the upper registers, while perforations in strategic panels give control of the middle registers.

The panels themselves are backed by air spaces and packing, variation of which allowed practically the only "tuning" necessary to satisfy the designers that they had achieved optimum reverberation characteristics.

RESONATORS AVAILABLE

The roof is made of a number of lateral surfaces, all of which help to break up the reflected waves and obtain their diffusion throughout the hall. A three-section reflector is suspended over the orchestra to perform a similar service, and complete the complicated acoustical design.



This unusual picture of the Festival Hall with stage erected for ballet illustrates the difficulties of multiple usage. Only a small proportion of seats is visible here.

In case undesired standing-wave effects should be built up between the roof and the floor space, a large number of holes were left in the roof surface into which it was proposed to fit resonators which would absorb the sound waves at various frequencies. In fact, they were never used, as there is little evidence of high or low spots throughout the hall. The designers aimed at a reverberation time of about 1.2 seconds, generally considered the most desirable in a hall of this size.

Immediately in front of the orchestra platform is a large slab of slate, intended to act as an additional reflector for sound waves. It was proposed that the players should be placed at almost the same level, and concentrated quite closely on a series of rising platforms to avoid undue dispersal of the sound source.

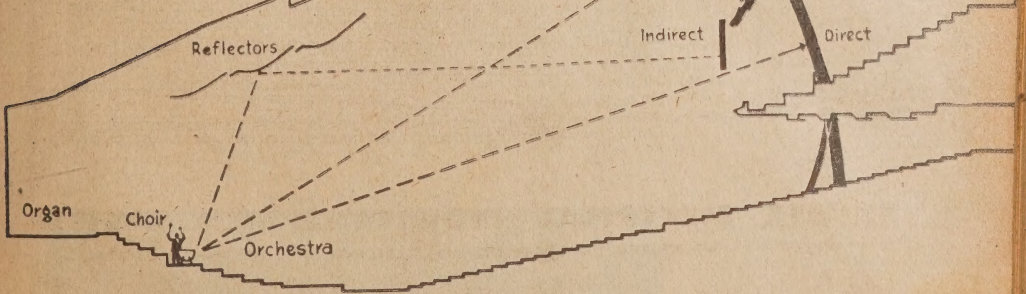
In practice this has not proved to be an important point, and the present platform is higher and larger than originally intended.

To keep the width of these orchestra rises to a minimum, special music-stands were designed on rollers which clipped into grooves at the front edge of each rise.

HOUSE LIGHTING

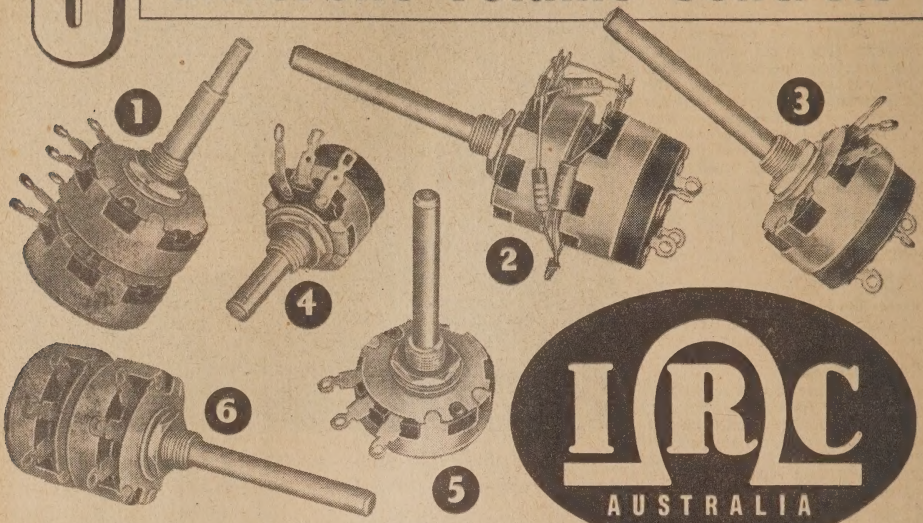
The psychological impact of lighting was carefully studied both as affecting the audience and the performers.

While the audience is filing in before the concert, building up that hum of anticipation which helps so much for a successful evening, the auditorium is lit from a large number of light points, each



A cross section of the hall showing how all seats receive the direct sound from the orchestra, followed a fraction of a second later by first order reflections from roof and walls. Only a few of the many possible sound paths are shown. No echoes are returned from the rear of the hall.

6 different volume controls



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The orchestral stage, on the other hand, lit by the same method, is much less brilliantly illuminated, on the theory that while the audience appreciates the stimulating effect of brilliant light at this time, the players do not.

As the concert is about to begin, the conditions are reversed.

The bright points of light are dimmed and the long fluorescent rods concealed in the folds of the roof are extinguished, one by one. At the same time, the lights for the orchestra come up to full strength, lighting up the players' desks from above and supplying them with the same sense of excitement previously enjoyed by the audience.

The warning signal which informs the populace that the performance is about to begin is fed through the foyers by amplifiers sounding an "A", the note upon which the players will tune up their instruments.

THE GRAND ORGAN

These are further examples of the thoughtful design which makes the Festival Hall such a memorable and superb venue for a musical evening.

The organ was added after the hall was built, and is a most unusual instrument, its layout being principally horizontal with no great depth to the array of pipes.

It was feared that their presence would interfere with the reflecting properties of the rear wall, and provision was made to cover them with sliding sections of wood when not in use.

In practice, however, it made little difference whether the pipes were covered or left open, although opinions differed as to the visual effect they have on the hall.

Personally, I thought they improved it considerably, particularly as they are illuminated with indirect lighting during concert performances, and are much more interesting to look at than would be a blank wall.

There have been frequent ballet performances in the hall, for which a special stage is erected.

It covers the space generally occupied by the orchestra, and gives hidden access to the doorways leading to the spacious rooms for the artists. It is generally agreed, however, that the hall is too large for this purpose, and those in the rear seats must suffer a big disadvantage through their remoteness from the stage.

How does it sound?

EXCEPTIONAL CLARITY

One's first impression is of the almost unbelievable clarity of all instruments, and the fact that this is preserved even when sitting at the rear of the hall. There is, of course, a difference between front and rear seats, as the ratio between direct and indirect sound changes, but there are no bad seats.

Because the hall is large, and because there are no echoes to build up resonance, there is a marked difference between the sheer volume of sound as compared with the ordinary hall.

Even with a full orchestra and choir, one does not feel that the auditorium is being completely filled.

This throws a big responsibility on the players themselves, and highlights the contrast between a powerful group and one not blessed with a full complement of first-class players.

The size of the hall has much to do with this, and it is generally agreed that an audience of 3000 is just about the limit even with a good orchestra.

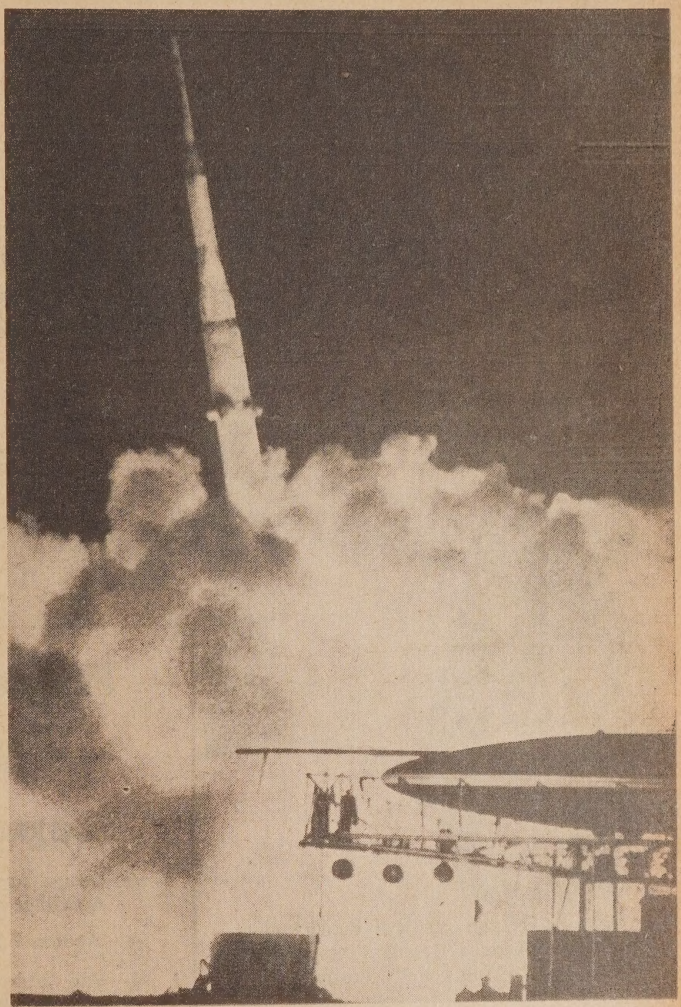
The same clean definition is there with smaller groups, but they would sound better in a small hall seating about 1000 people, which is the size of the second hall proposed for Sydney.

One could criticise the apparent deficiency in the bass instruments and suggest that the brilliance of the acoustics favors brass, tympani and cymbals.

But the designers themselves admit that there are no hard-and-fast rules for individual taste in sound, and held three trial concerts before opening day in an endeavor to gauge public reaction to their efforts.

Few people would seriously suggest any attempts to alter materially the balance which was achieved by science and good guessing, and back up this view by packing the Hall almost every night all the year round.

ROCKET SETS SAIL TO THE STARS



THIS remarkable picture shows the Lockheed X-17 ballistic rocket at the moment of firing. This rocket, which weighs six tons, is setting off for a journey of discovery into the ionosphere, bearing a war-head packed with instruments to record the conditions met with. The rocket is as high as a four-storey building; its lower half is obscured by the clouds of smoke and flame from the propellant which is lifting it from earth.

Soon it will pierce the ionosphere, a layer of very thin air fifty miles above the ground and continue on to an undisclosed altitude, after which it will plunge back to the earth. The information it carries will be used to solve the problems which arise when the warhead of a ballistic missile re-enters the earth's atmosphere at high speed. By using the rocket instead of a full scale operational missile, it is possible to save millions of pounds in developing intercontinental and intermediate range vehicles.

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AMATEUR RECEIVES B.B.C. TELEVISION IN AUSTRALIA

For some years, reception of the BBC Television broadcasts on Channel I have been received in various parts of the world, but this report from Norman Burton, a Sydney amateur, is the first we have heard from an Australian. Mr. Burton has received verification from the BBC, and tells how he did it.

DURING the spring of 1956 I was consistently receiving American signals on frequencies up to 40 M/cs and towards the middle of October reports began to reach me of reception of Crystal Palace transmissions in parts of Africa and also USA.

I thought therefore, that it might be possible to receive these signals here in Sydney.

I searched all my own references to long distance reception of the London TV signals, and found that these, with one exception, were all either over a North/South path (Africa) or an East/West path (USA). The only recorded case of West-East reception was in India before the war.

LACK OF INFORMATION

The most obvious thing that emerged from this data was the lack of information about the path London/Sydney when single figure wavelengths were involved. The obvious thing to do, therefore, was to try it!

I obtained the program times of the BBC TV Service, and after studying them, I selected the time of the Saturday noon transmission as the most likely to offer success, basing my suppositions on propagation conditions for 10 meters.

The BBC was advised that a watch was being kept at this time, and on Saturday, October 20, watch keeping was commenced.

To begin with, I had erected a 3-section vertical Franklin aerial with a reflector as holding promise. It may have been OK in a quiet location, but at my address I am sure I could hear every car within a 50-mile radius of the house.

A NEW AERIAL

The following weekend a tilted wire, 3 half waves long with phasing sections, was erected in place of the Franklin. This was directional on London over the short path, and on this evening, October 27, signals were heard on the Sound Channel (41.5 Mc/s) at 1322 GMT.

The following week a two-element beam was installed. On Saturday night, November 3, very strong signals were received on the sound channel. These persisted with fading from 1025 GMT until 1155 GMT.

As waves of this length arrive over a long distance elliptically polarised, it is immaterial whether the aerial is erected horizontally or vertically. I chose the former orientation as auto noise is less in evidence.

By now I was in possession of data from the BBC, which enabled me to keep nightly watch, Monday to Saturday, from 1000 GMT. onwards. After a few nights I found it possible to predict with reasonable accuracy whether or not signals would come through by observing certain other services and by the "noise" on the 41.5 M/cs channel.

Signals were heard often until December 22 last, since when no reception has been recorded.

MOSTLY SOUND

Most of the observations were made on the sound channel, but the vision channel, 45 M/cs, has also been heard on a few occasions. On one of these it was so strong that had a BBC standards TV set been available, I am quite confident a picture would have been obtained.

Tape recordings have been made of the sound channel. The first tape I did not like, and when a night or two later signals promised to be far better, I wiped it out. But radio is a perverse creature. Conditions deteriorated, and I have a worse tape than before. I hope, however, to make further tapes.

The hardest part was to get positive identification of the signals. The signals I heard were those of the Morning Trade Test Transmissions. They consist on the Sound channel of music from tapes—the same music daily—and on the Vision channel Test Card "C" is radiated.

There are no voice announcements.

IDENTIFICATION

I noticed that at 1047GMT, Tape 1A ceased, and whilst Tape IB was being installed, a constant 900 c/s tone was radiated. My wife identified two consecutive pieces radiated from 1102 on. These were accurately timed, and the combination of these, plus the 900 c/s tone, enabled the BBC to identify and verify that the signals originated from the London transmitters of the BBC TV service

The experiment is still proceeding and will do so for a few weeks, after which it will be suspended till later in the year, when the matter will again be pursued with, I hope, a suitable TV set.

The receiver is a Hallicrafter SX28. The equipment is switched on an hour before London is due on the air.

(Continued on Page 13)

TELEVISION PICTURE AT TAREE

Predictions of long distance reception of TV signals are rapidly being fulfilled Recently we received this picture from Mr. P. O. Calvin, of Manning St., Taree, showing the screen of his TV set receiving a Sydney station. It is obvious that the image on the screen would have been much better than is apparent from the photograph. Mr. Calvin reports that reception is regular and that his aerial points inland. This would suggest a reflective path between transmitter and receiver. Still more recently Mr. Crosby Walch in Hobart has reported reception of Sydney TV sound signals over a distance of approximately 650 miles. He used a specially built receiver and aerial, but believes that the station was strong enough to have given a picture on a TV set.

Melbourne signals are regularly received on the Tasmanian north coast and many consider that with good aerial systems useful programs will result.

FOREMOST IN SOUND

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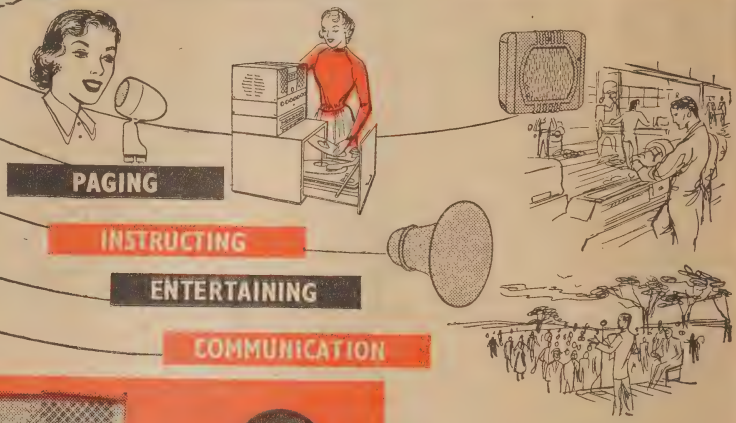

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FUTURE HEATING MAY BE ATOMIC POWERED

Within a few decades, factories, office buildings and other large structures may be heated atomically without a speck of soot, an ounce of ash or a cubic foot of smog. S. L. Nelson, manager of one of the processing operations at the General Electric Hanford atomic plant, says that successful use of reactor waste heat for Hanford buildings has shown dirt-free atomic heating to be technically feasible.

BUT the success of his predictions depends on making atomic fuel available for heating purposes, design of a reactor specifically for low-energy heat production and overall reductions in costs of building and operating reactors.

Atomic technology is fully capable of producing a long-life, low-powered safe reactor, suitable for space heating. Although not enough work has been done on the economic aspects of atomic space heating to make any evaluation, a preliminary glance indicates that for some applications it would be attractive even now, according to Nelson.

The Atomic Energy Commission already has laid the groundwork for standardisation and control of such systems, but the remaining problem is still fuel. At present this fuel is channelled into more urgent projects.

The fascinating business of getting motive power from the atom claims so much attention that engineers and scientists generally overlook one important potential—utilisation of raw energy as it comes from the atom nucleus in the form of heat.

Producing power with atomic reactors involves many expensive problems which shrink to insignificance if low pressures and temperatures below the boiling point of water can satisfy the designer.

While not worth much for driving a turbine, this range of heat does nicely for space heating, as in the new Hanford atomic energy space heating system.

The Hanford heating system works this way:

Water from the Columbia River is pumped through reactors used in producing plutonium. This water cools the reactor and picks up immense amounts of heat, along with a slight amount of radioactivity.

The reactor cooling water then is pumped to an outside heat exchanger, where it gives up its heat to an ethylene glycol water solution. The ethylene glycol solution is circulated to air-conditioning systems in reactor buildings, operations buildings, administrative offices and maintenance shops.

Ethylene glycol is used to prevent freezing in outside air-conditioner coils during sub-freezing weather.

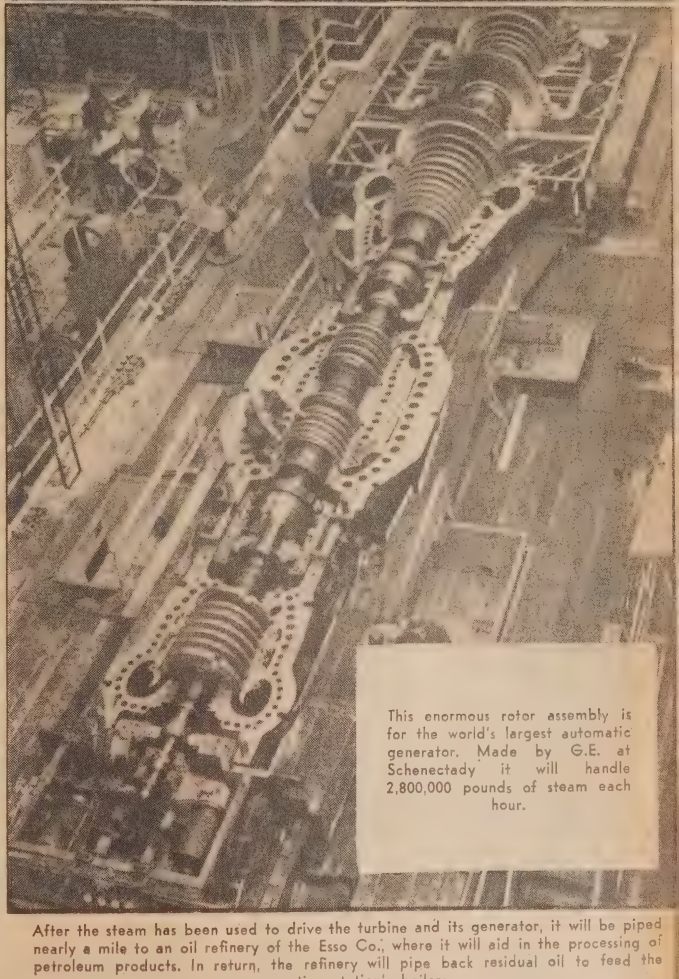
Safety of the system is assured by maintenance of higher pressure in the secondary ethylene glycol system than in the reactor coolant water. If a leak should develop, the flow would be from the non-radioactive fluid into the radioactive fluid, thus preventing radioactive water from getting into the heating system.

The Hanford installation has shown itself to be a remarkably sound and trouble-free system.

Although development projects often operate at a loss, this system will make a profit, saving the taxpayers a net of about 60,000 dollars a year after a three to seven-year amortisation.

Enough heat is recovered in the system to heat more than 1000 average-sized houses during the winter season.

TURBINES ON THE HALF SHELL



This enormous rotor assembly is for the world's largest automatic generator. Made by G.E. at Schenectady it will handle 2,800,000 pounds of steam each hour.

After the steam has been used to drive the turbine and its generator, it will be piped nearly a mile to an oil refinery of the Esso Co., where it will aid in the processing of petroleum products. In return, the refinery will pipe back residual oil to feed the generating station's boilers.

BBC TV PROGRAMMES RECEIVED IN SYDNEY

(Cont. from Page 11)

warm up. The station timepiece is carefully checked against WWVH and five minutes before London is due on the air the receiver is put on 41.5 M/cs by means of a 500 K/cs crystal standard. The harmonics of this are counted upwards from 30 M/cs, where a second accurate check is available. Once on frequency, the receiver is left tuned, the standard being turned on every 10 or 15 minutes as a frequency check.

The main interest of the experiment has been the fact, apart from it being the longest distance over which BBC TV signals have been heard, that part of the path is in darkness. All other BBC TV DX reception has been on daylight paths.

The signals normally suffered from deep fading, but on many occasions they were loud enough to make the volume uncomfortable in a room 17ft x 12ft! Flash! Mr. Burton reports reception of French TV station on February 7, at 1003 GMT.

A NEW LIFE IS SAVED—This dramatic picture shows a blood transfusion of a young baby whose unsuitable blood supply was changed twice to prevent its certain death.

The Mystery of Living Cells

The nature of life is not yet completely understood. Scientists are conducting a ceaseless investigation into this eternal mystery. Biochemical models are used to help unravel the complex nature and mysteries of the living cells, which continually poses new problems.

by Calvin Walters

LET there be no misunderstanding. I do not refer in any way to ladies with peroxided hair or other chemically induced adornments. Neither do I mean ladies whose biochemical activity has produced a pleasing physical structure so necessary for a model.

The subjects of this article are quite different but nevertheless almost as interesting.

It has long been the ambition of surgeons to replace diseased organs of the human body with new and healthy ones.

ORGAN EXCHANGE

Needless to say it is also the dream of people equipped with such diseased organs to be able to have a new heart, kidney, liver, eye, ear and so on as required.

As knowledge of the functions of our internal organs increased and the science of biochemistry advanced it was thought that sufficient light would be thrown on the matter to enable the surgeon to transplant healthy organs into the human body.

It didn't work out that way for, with the advance of biochemistry, it soon became apparent that human tissue contains many different factors which can be combined in millions of different ways. Thus there are millions of different individuals each possessing their own characteristics which are so pronounced as to make it well-nigh impossible to find two alike.

These biochemical differences make the matter of transplanting organs extremely difficult. The organ from one individual may not grow in another. Even the grafting of skin from one person to another is a hazard. Such skin will most probably die or wither after a time.

Certain kinds of grafting seem to be possible and successful, such as the grafting of corneas from the eye, but any grafting of organs which have to do with the supply of blood and nourishment to the body seems to be extremely difficult if not impossible.

BLOOD JUNCTION

The blood serves to transport nourishment to every part of the body through the medium of different organs. It also removes waste products from the body by other organs. Therefore the internal organs' job is to chemically modify the blood.

As there are millions of different individuals as mentioned previously it follows that their organs are also individual to them. To make a successful graft of an organ the surgeon is confronted with the almost impossible problem of finding two similar persons from the millions.

In the case of the transfusion of blood the matter is somewhat modified. There are certain known blood groups and blood from these groups can be transfused with safety into people of the same grouping. The internal organs of the recipient make the necessary modifications to adapt the new blood to the recipient's individuality.

It is the cells of the human tissue which contain the substances which give to the person his individuality. These substances are the protoplasm, cytoplasm, chromosomes, genes and certain chemicals. These substances seem to be fixed and absolute to the individual and cannot be transplanted.

For centuries scientists have been trying to find just what keeps the living person going.

WHAT KEEPS US ALIVE?

To the layman speaking of some of his acquaintances this may be easily answered. He will say that what keeps so and so going is beer. Of another, aspirin, or drugs or oysters, raw vegetable juice, milk and so on.

We don't mean this. What scientists have been trying to find is the chemical reactions which take place inside the cells of tissue which maintain growth, activity, reproduction, life itself.

In their experiments scientists have found some very peculiar chemical set-

ups which behave in the same way as the human cell.

About the simplest form of living thing is a single living cell called an amoeba. It crawls around, encircles its food digests it and having fed ejects the remainder as waste.

The amoeba, after a certain stage in its growth has been reached, divides into two and each section becomes a new individual exactly the same as the first and capable of reproducing itself in the same way.

If a drop of chloroform is floated on the surface of a glass of water and an attempt be made to pierce it with a fine glass rod the chloroform will resist. If the glass rod is tipped with shellac and the attempt to pierce the drop of chloroform repeated the glass rod will be sucked into the drop. When the shellac has been "eaten" off the glass rod by the chloroform the latter will again show its aversion to glass and eject the rod. This behaviour of the chloroform is in every way the same as the amoeba.

MATERIAL DIVISION

Again, if a drop of oil is floated on water and it is touched on opposite sides with two pieces of soda it will divide into two drops just the same as an amoeba.

The reason for the oil dividing is a simple matter of surface tension. At the two points of contact of the soda the surface tension of the drop is lowered. Therefore the surface tension at the "equator" of the drop is relatively greater and the drop will divide.

There are lots of chemicals which, when brought into solution, will crystallise, throw out shoots, divide and multiply in much the same way as the cells of living tissue.

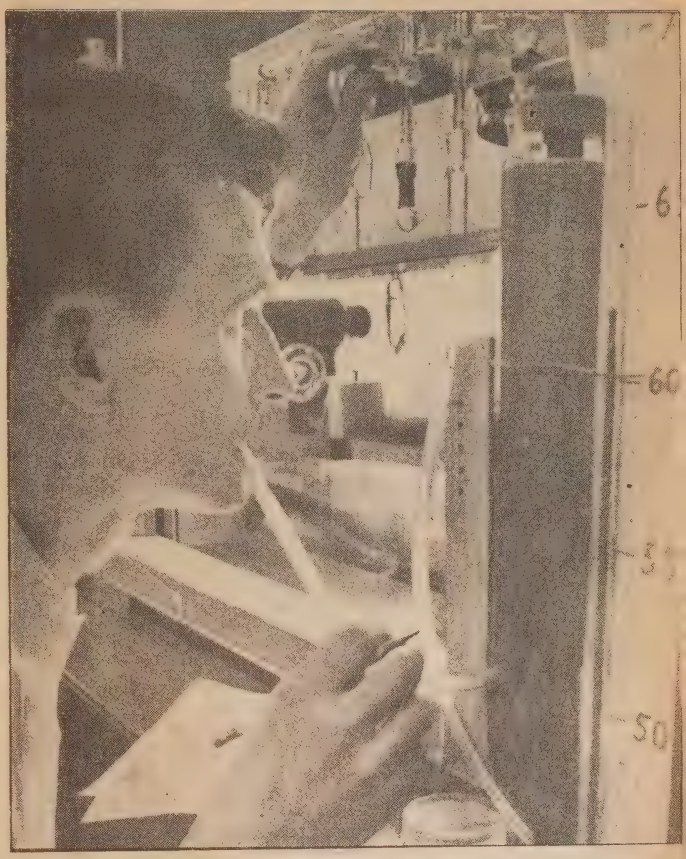
All these behaviours of the chloroform, the oil, the crystals and other chemical phenomena can be explained by the scientist in terms of the many laws of chemical affinity, osmosis, surface tension, solution and so on.

The problem then becomes this. Are the physical and chemical changes which take place throughout the life of the living cell governed by these same laws?

Scientists reason that if the elements such as carbon, nitrogen, oxygen, hydrogen, sodium, potassium and so forth which constitute the living cell are the same as those existing in the earth atmosphere and the sea then it should be an easy matter to construct physio-chemical machines which will carry out the functions of the living cell or at least duplicate the results of those processes.

According to George W. Gray this has been done in several laboratories in

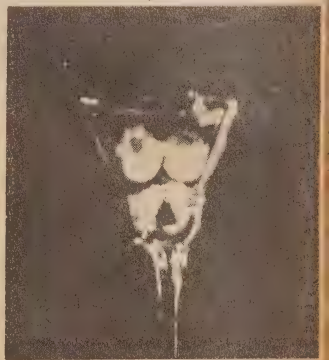
SCIENTIST WEIGHS AN AMOEBA



Californian biologist David Prescott puffs into a tube to balnace the weight of an amoeba with air pressure. The amoeba is in the tube at his left hand. Amoeba weighed 1/70,000,000 ounce..

The amoeba spreads its armlike pseudopods.

Next it rolls itself into a ball.



Finally it splits into two in unique reproduction.

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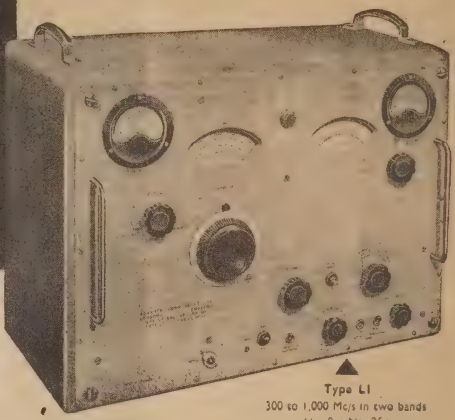

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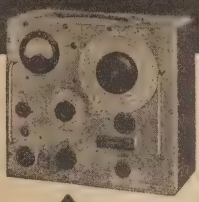

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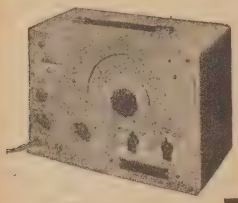

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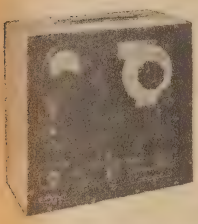

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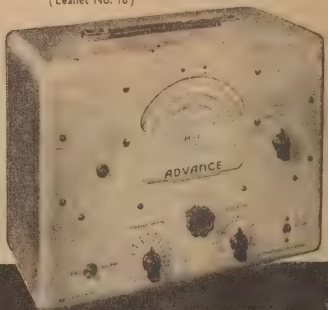

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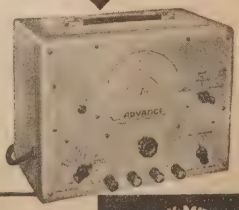

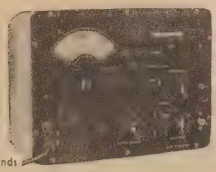

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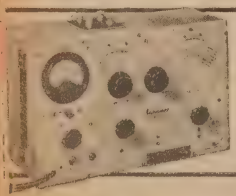

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America with two different aims. One type of machine is a working substitute for the living organ, while the second is called a "biological model" built mainly to test a theory and thus help to understand the organ itself.

One of the most interesting of the latter type is that dealing with the mystery of protoplasm, that extremely complex and vital substance which is the main constituent of the living cell.

In appearance protoplasm is a jelly-like liquid enclosed within the cell wall.

For a long time protoplasm presented a mysterious problem inasmuch that it gives an acid reaction whereas the bloodstream which surrounds and irrigates the cells is alkaline.

THIN WALL

The protoplasm is enclosed in a very thin wall through which diffuses the nourishing materials from the blood into the protoplasm and through which diffuses outwards into the bloodstream the waste products generated within the cell.

Now while the affinity between acid and alkali is one of the most pronounced reactions known to chemistry, the acid of the protoplasm and the alkali of the blood never seem to neutralise each other despite the fact that they are only separated by a thin membrane through which the nutrient substances pass from the blood and waste products pass outwards into the blood.

Furthermore the protoplasm of the cell is rich in the element potassium and quite deficient in sodium while the surrounding blood, separated from the protoplasm by the thin membrane, is rich in sodium and deficient in potassium.

The protoplasmic cell therefore in some way takes in potassium from the blood which is deficient in that element and excludes the sodium which is prolific in the bloodstream.

Sometimes the concentration of potassium in the cell is 40 times that of the surrounding blood.

UPWARD FLOW

This latter fact has inspired the analogy drawn by George W. Gray. He likens the paradox to water running uphill, like a head of water gauged at a pressure of 100lb to the square inch steadily flowing upward to a tank where the pressure was 4000lb to the square inch.

All sorts of hypotheses were advanced to explain why the cell was capable of working against the energy gradient in a manner similar to water running uphill. None of the theories advanced was amenable to test, mainly for the reason that any experiments on the all sensitive protoplasm were not conclusive because one could not be sure that the composition and behavior of injured protoplasm was the same as in the uninjured.

To solve the problem Dr. W. J. V. Osterhout, of the Rockefeller Institute for Medical Research, carried out experiments on a marine plant called Valonia.

This plant is one of a species of marine life which grows as a scum on the surface of water. It has a difference in that, while most algae consist of many cells joined together in a long filament and are of microscopic size, the valonia is an individual cell growing to the size of a small pigeon's egg. It is a single cell of living matter consisting of an outer wall of cellulose with a thin layer of protoplasm clinging to the inside and then an interior cavity filled with sap. The whole cell is surrounded with sea water just as a human cell is surrounded with blood.

Fine glass tubes ground to a needle point were inserted through the wall of the cell and left there until the wound had healed and the valonia cell functioned normally.

Then experiments were conducted by withdrawing sap and introducing other substances.

SELECTIVE AGENT

It was found that although the seawater was rich in sodium and relatively deficient in potassium the sap of valonia was rich in potassium to the extent of 40 times that of seawater and the sap contained little sodium. This was remarkably like the behavior of the human cell.

The cellulose wall of valonia was found to be permeable in either direction to both elements. Therefore, it was reasoned it was in the protoplasm that the agent selective to potassium must be found.

It was discovered that, although the protoplasmic layer of valonia is only about one two hundred and fiftieth of an inch thick it nevertheless consists of firstly a film of oily material, then a layer of watery material followed by another inner layer of oily material.

IMPORTANCE OF FILM

Dr. Osterhout found that it was in the outer layer of oily film that the selective process lay. By puncturing only this film and leaving the rest intact all the accumulated potassium in the sap flowed outwards into the sea and the sap contained the same dilution as the surrounding sea water and the cell died.

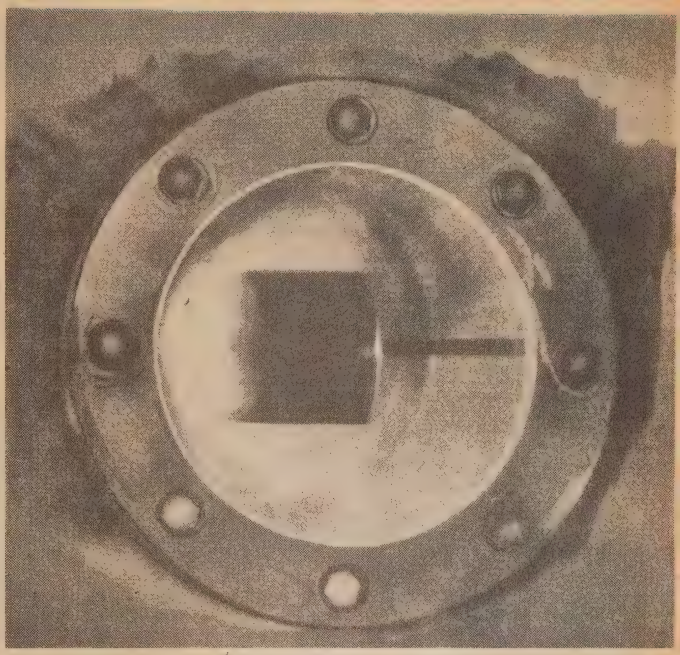
Final results of the experiments showed that potassium and sodium salts exist in the sea in alkaline compounds and both can pass through the oily film as whole molecules. But some molecules move faster than others and potassium moves faster than sodium, therefore potassium "gets there first" as it were and sodium gets no chance.

While potassium passes through the protoplasmic layer as a potassium salt it comes in contact with the sap and changes into potassium hydrocarbonate because the sap contains carbonic acid and potassium has a stronger affinity for carbonic acid than has sodium.

Potassium hydrocarbonate immediately dissolves in the sap and thus the carbonic acid in the sap is con-

(Continued on Page 69)

TESTING AT HYPERSONIC SPEED



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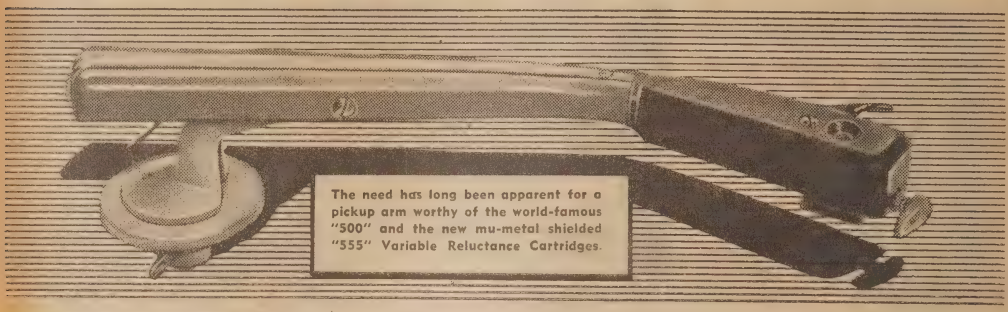

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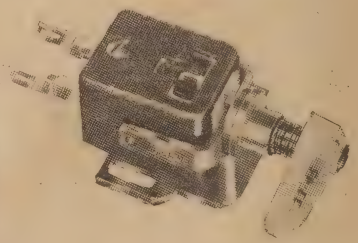

Type "555"D. Cartridge only, with Diamond L.P. and Sapphire standard styli Retail Price £12/10/-

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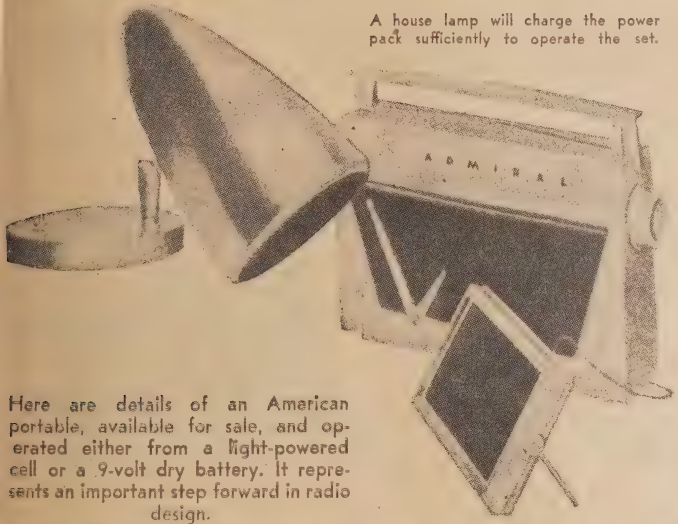
Technical Review



A house lamp will charge the power pack sufficiently to operate the set.

Here are details of an American portable, available for sale, and operated either from a light-powered cell or a 9-volt dry battery. It represents an important step forward in radio design.

SOUND FROM THE SUNLIGHT

IT has long been known that the energy the earth receives from the sun is equivalent to approximately one and one-half horsepower per square yard.. Theoretically, if this energy were harnessed, it could provide an economical and reliable source of universal power. For over two thousand years the world's scientists have searched for an efficient solar-energy conversion method whereby this free source of power could be put to work.

About two years ago the Bell Telephone Laboratories presented to the National Academy of Sciences a "solar battery". This amazing device could enslave power from the sun by transferring solar energy directly, instantly, and efficiently into electrical energy.

THE SOLAR BATTERY

The discovery of the solar battery developed out of the study of semiconductors of electricity based on the p-n junction used in transistors. This junction, in this case, is a slice of silicon—the second most abundant element on earth.

First the silicon must be purified until the ratio of non-silicon atoms is 1 to 10,000,000; for although silicon represents 2.5 pc of the earth's crust, pure silicon is rarely found.

Then the purified silicon is contaminated deliberately with a minute amount of impurity. This treatment causes the silicon slice to become n or negative-conductive material. The slice of silicon is treated again by heating it in a tube containing still another impurity. This creates a shallow p or positive layer on the surface.

The result of the process is a p-n junction. When the silicon is now exposed to light, the surface becomes positive and the interior negative. With wires connected to the exterior and interior of the silicon, a voltage potential is available for useful work.

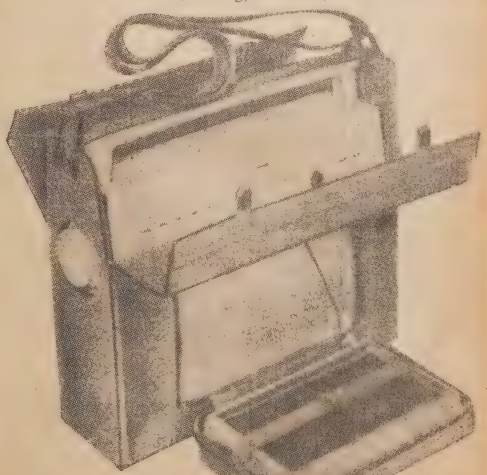
The solar battery utilises 6 pc of the energy received from the sun. In efficiency, this far exceeds that of thermocouples and photoelectric cells. In fact, it compares favorably with the efficiency of steam and gasoline engines. It can be seen readily why researchers envisioned that some day solar batteries, possibly containing many silicon cells, would supply cheap, reliable power for home and industrial use.

After 18 months of development work, Admiral Corporation introduced the world's first sun-powered tubeless radio designed for the consumer market.

The solar battery ("Sun Power Pak") developed to power the radio consists of 32 individual quarter sections of silicon solar cells connected in series. This arrangement delivers a total of 9 volts at 15 milliamperes.

The solar cells of the battery are encased in a block of clear plastic with a silicon oil centre. The plastic covering and oil centre not only allow the best focusing of sun on the surface of the silicon cells, they also protect the cells from shock damage.

The block measures approximately 6in long, 4in wide, and ¼in thick. The



A zip-open holder in leather case permits exposure of the sun battery.

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Note Pickup heads are complete with diamond styli.

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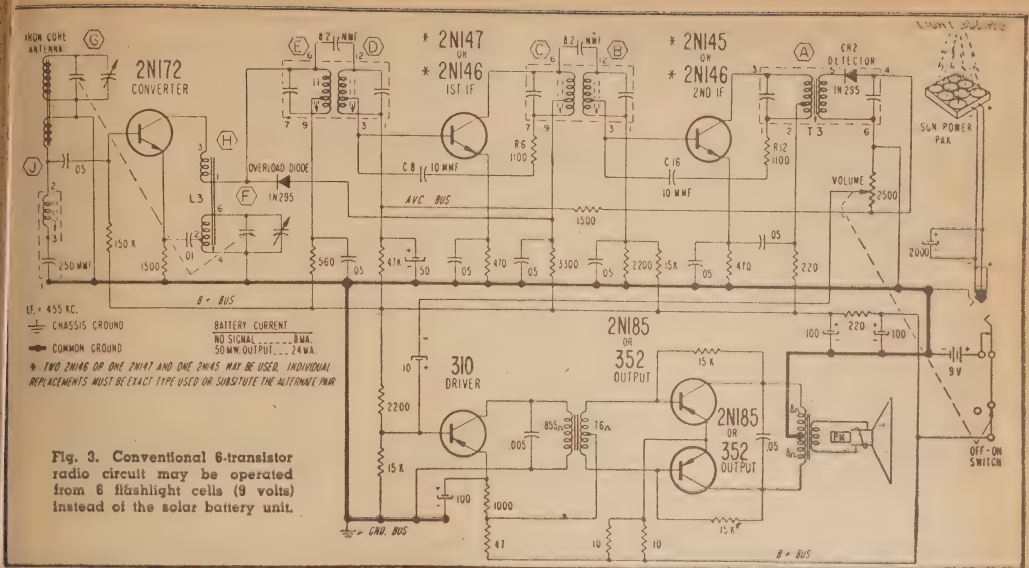
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* 2N145 OR * 2N146 2ND IF
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2N185 OR 352 OUTPUT
9V
OFF-ON SWITCH
B+ BUS
CHASSIS GROUND
COMMON GROUND
BATTERY CURRENT
NO SIGNAL 8MA.
50 MW. OUTPUT 24 MA.
* TWO 2N146 OR ONE 2N147 AND ONE 2N145 MAY BE USED. INDIVIDUAL REPLACEMENTS MUST BE EXACT TYPE USED OR SUBSTITUTE THE ALTERNATE PAIR
GND. BUS

Fig. 3. Conventional 6-transistor radio circuit may be operated from 6 flashlight cells (9 volts) instead of the solar battery unit.

solar battery is mounted in a common carrying case with its associated receiver during actual use, in such a way that it can be exposed to light while the receiver is in operation.

The solar cells are most efficient when exposed to light of the upper spectral region ranging from red to infra-red. They can convert more than 15 pc of the sunlight they receive into electrical power.

The unit is so sensitive it can operate satisfactorily on overcast days, or from an artificial source of light such as an electric bulb or infra-red lamp. It can operate over a temperature range of 185 degrees to minus 60 degrees (Fahrenheit).

The radio used with the "Sun Power Pak", automation-produced, contains six transistors and two germanium diodes. It has a maximum power output of 250 milliwatts and a sensitivity of 175 microvolts. Printed wiring is used throughout the chassis.

BATTERY OPERATION

Without the "Sun Power Pak", the tubeless radio can be operated by six flashlight batteries. Because the set requires less than one-tenth the power consumed by a conventional portable radio (15mA), the batteries will last from 700 to 1000 hours before requiring replacement.

Circuit features are as follows: A 2N172 n-p-n transistor is used as an autodyne converter, two 2N146 or one 2N147 and one 2N145 n-p-n transistors are used for the 1st and 2nd IF amplifiers.

Transistors, like triode tubes, must be neutralised when used as RF amplifiers. Capacitor C^8 and resistor R^6, also C^{16} and R^{12}, provide feedback in each stage that is equal and opposite in polarity to the feedback through the relatively high base-to-collector capacity.

Since transistor amplifiers have a low input impedance, special tapped IF transformers are used. The 1st and 2nd IF transformers are double tuned to provide optimum bandwidth consistent with good selectivity.

The overload diode conducts on strong signals, and its shunt resistance across the primary of the 1st IF transformer reduces the gain of the circuit to prevent overloading in a strong signal area. This diode, therefore, acts to "assist" the more conventional AVC action provided by the bias fed to the 1st IF amplifier from the second-detector diode, CR^2.

The second detector is a standard 1N295 germanium diode. A type 310 p-n-p transistor is used as a first audio amplifier and driver to supply the audio-output amplifier. The output stage uses two 352 p-n-p transistors operated as a push-pull class "B" amplifier.

The "Sun Power Pak" is sold as an accessory item. When it is plugged into the jack on the back of the radio, the regular battery is disconnected. The radio will then play on electrical energy from the sun or a 150-watt lamp.

The selling price of the "Sun Power Pak" is 185 dollars. The price seems high until one realises that pure silicon, from which it is made, presently costs over 300 dollars a lb. Eventually, the cost will be reduced as metallurgists develop new refining methods along with mass production efficiencies. Nevertheless, the "Sun Power Pak" radio and the unlimited potential which it represents are important electronic achievements.

— Radio and TV News

REMOTE HANDS HAVE LIGHT TOUCH

The New South Wales University of Technology has recently acquired a Master-Slave Manipulator, the only one in Australia, which was on display at the Australian Atomic Energy Commission's Exhibition held last month.

THE manipulator was developed for the remote handling of radio-active, toxic and explosive materials which would be too dangerous for any other method.

The artificial hands are located in the dangerous area, and the operator in safety inserts the thumb and two fingers of each hand into three metal stalls.

The tongs at the end of the slave arms then follow exactly the operator's wishes.

In a physics laboratory, the operator would see into the radio-active room through a window made of several slabs of lead-shielding glass, each about 9in thick. The spaces between them would be filled with clear mineral oil. This makes the window in effect a single block of glass by preventing multiple reflections.

Motive power comes from small electric motors on each manipulator, which move the slave arms through an arc of 110 degrees for a 60 degree movement of the operator's arms.

The master arms are fitted with counter balances which move automatically to preserve the delicate equilibrium so that the touch is finger-light. At all times the master arms hand vertically irrespective of the angle of the slave arms.

The tongs on the slave arms can be locked in any position to save fatigue on the part of the operator who must often maintain a grip for long periods.

In demonstrating the flexibility of the device, an operator can adjust a bow tie and even thread beads on a needle.

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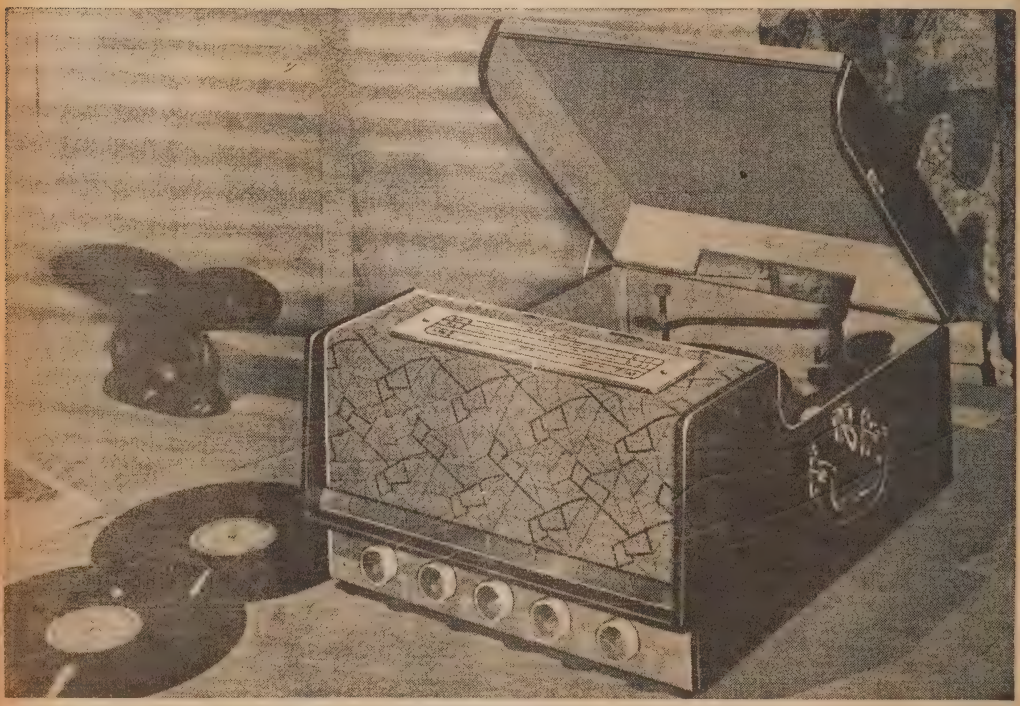

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SIMPLE CAPACITANCE BRIDGE USES TRANSISTORS

Here is a design which should interest readers who like to experiment with unusual circuits. One transistor, as an audio oscillator, energises a bridge measuring circuit. A second transistor operates as an audio amplifier, allowing balance point to be observed with earphones.

By LEONARD J. D'AIRO

I'VE noticed that in the shop the least often measured electrical quantity is capacitance, though it is one of the building blocks of electronic circuits.

Many a time I've sweated over circuits to the point of despair just because of miscoded or unmarked capacitors.

You have probably had trouble with capacitors in television horizontal oscillator and sync circuits where you have had to try one capacitor after another until you hit one which would make the circuit operate properly — such is the tolerance in marked values.

After taking all that I could I decided to do something about this problem once and for all and give my ulcers a rest. The result is the transistorised capacitance bridge described.

The unit is built into an old portable ohmmeter case and is self-contained. It uses two type CK722 transistors, one of which is an audio oscillator and the other an audio amplifier. A single 9-volt battery supplies the power. Current drain is 1 ma. With five ranges, capacitances from 10 pf to 1 mfd can be measured.

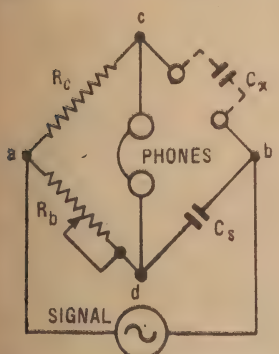


Figure 1: The basic bridge circuit. In the practical instrument, one transistor as an audio oscillator supplies the input signal. A second transistor, as an amplifier, makes the instrument more sensitive and precise.

The bridge circuit (Fig. 1) is simple. Cx is the unknown capacitance, Cs the standard capacitance, Rb the balancing resistor and Rc the calibrating resistor.

The bridge is in balance when the ratio of Cx to Rb is equal to the ratio of Cs to Rc. This is expressed mathematically as Cx equals Rb (Cs/Rc).

If an audio signal is applied to points a and b on the bridge and a pair of headphones connected to points c and d the signal will be heard in the phones when the bridge is unbalanced.

As Rb is adjusted toward the point of balance the signal in the phones begins to decrease until nothing is heard. This point is called the null and shows that the bridge is balanced.

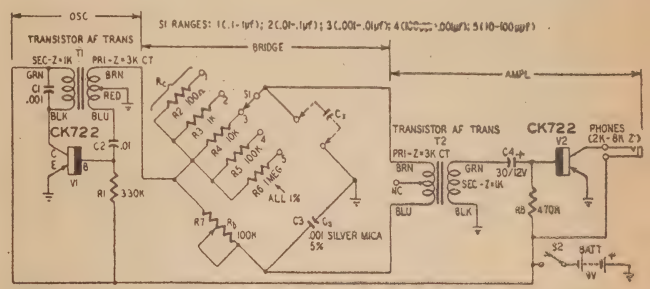
Now, when Cs is equal to .001 mfd and Rb is equal to 100,000 ohms the bridge will indicate values of 0.1 mfd to 1 mfd when Rc is equal to 100 ohms; .01 mfd to 0.1 mfd when Rc is 1000 ohms, etc.

To cover the range of 10 pf to 1 mfd five calibrating resistors are used, each one switched into the circuit as needed.

These resistors will multiply the dial reading by 0.1, .01, .001, .0001 and .00001 times respectively.

Since the setting of the balancing resistor is proportional to the unknown capacitance a linear-taper potentiometer can be used and the dial calibration will be linear.

The complete schematic diagram of the capacitance bridge is shown in Fig. 2. One CK722, as the oscillator, supplies the audio signal to the bridge.



R1—330,000 ohms
R2—100 ohms, 1% (0.1-1-μf range)
R3—1,000 ohms, 1% (.01-0.1-μf range)
R4—10,000 ohms, 1% (.001-.01-μf range)
R5—100,000 ohms, 1% (.0001-.001-μf range)
R6—1 megohm, 1% (10-100-μμf range)
R7—100,000-ohm pot, linear
R8—470,000 ohms
All resistors ½ watt
C1—.001 μf, disc ceramic
C2—.01 μf, disc ceramic
C3—.001 μf, silver mica, 5%
C4—30 μf, 12 volts, miniature electrolytic
T1, 2—miniature audio transformers, primary 3,000 ohms ct, secondary 1,000 ohms (Argonne AR113 or equivalent)
BATT—Miniature 9-volt mercury battery
V1, 2—CK722 transistors
S1—single-pole 5-position rotary switch
S2—spst switch
Miniature phone jack
Phone tip jacks (2)

Figure 2: The complete schematic diagram of the capacitance bridge. The CK722 transistors may not be available locally but other general-purpose audio types could be used equally well.

AUDIO OUTPUT

The output of the bridge is then fed to the second CK722, an audio amplifier. The output of the bridge is amplified so that a finer null indication can be obtained for greater accuracy.

Although I built the bridge in the ohmmeter case it is not necessary to do likewise. There are no critical circuits, therefore layout and construction can be tailored to your own requirements.

The dial for Rb was made from heavy paper glued to the panel with a coating of dope for protection.

To calibrate the bridge it is necessary only to use an ohmmeter connected to one side and the wiper arm of Rb.

Starting at minimum resistance, rotate the shaft toward maximum resistance marking off on the dial each increase of 10,000 ohms.

COMPARATIVE METHOD

If a more accurate standard of resistance can be arranged, so much the better. Instead of taking the ohmmeter reading as absolute the meter can be used to compare settings of the variable resistor with fixed resistors known to be accurate.

The 10,000-ohm point is 1, the second 10,000-ohm point is 2, and so on up to 10.

When Rc is 100 ohms these numbers indicate capacitances of 0.1 mfd, 0.2 mfd, 0.3 mfd, etc.; when Rc is 1000 ohms the numbers indicate .01 mfd, .02 mfd, .03 mfd, and so on.

This calibration will hold true for all ranges provided that each Rc resistor is exactly 10 times the previous resistor and all are held to close tolerances. If not, then each range will have to be calibrated individually with known-value capacitors.

It is well worth the time, effort and money spent building this bridge when you think of the aggravation avoided when you use it. I know. — Radio Electronics.

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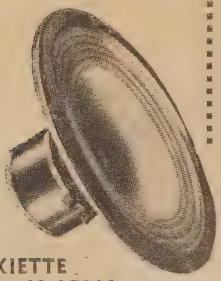

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NEWS AND VIEWS OF THE MONTH

The busy BBC

THE year 1956 was a busy one for television activities of the BBC, according to figures recently released.

During the year its audience of adult viewers grew from 14,450,000 to about 17,500,000. At the beginning of the year BBC television was within the reach of 93 pc of the adult population of the United Kingdom; at the end of the year within the reach of 97 pc. In the course of the year BBC television viewers saw about 30,000 artists and speakers. This estimate is based on the 23,400 contracts sent out in the period, some of which were for groups of artists—such as dance teams—and musicians.

The light entertainment department staged 565 "live" shows from the BBC's London studios, equal to 320 hours of transmission. This figure takes no account of the number of entertainment shows on film or of programs from BBC studio centres outside London. In the course of the year the television drama department presented 70 studio plays running 90 minutes or more, 46 other plays of shorter lengths, six outside broadcasts of full-length plays and 11 drama series or serials amounting to 84 weekly episodes.

Color and fatigue

AN investigation into effects of color in French factories revealed that too bright shades cause fatigue.

Colors should be subdued but gay.

Cold colors are best, as warm colors have an adverse effect on the nerves.

Yellow used with a light touch of grey caused an increase in output in one factory.

Color schemes have spread from workshop to office, but less contrasting tones are recommended.

Office furniture needs color, according to investigators, and often has a good effect on clients.

Typewriter and calculating machines should have colored keyboards. Blue, green and light grey are best.

In the forthcoming Paris annual international trade fair colored office furniture will be featured.

British scatter link

IN common with other countries, intensive research into Tropospheric Scatter is being carried out in Britain. Marconi's, who have been conducting tests for many years, have now established an experimental 200 mile (approx. 322 km) tropospheric scatter link between the north and south of England, and hope shortly to extend the link a further 200 miles into Scotland.

The link has been in continuous operation for six months, and results are such as to indicate a sound commercial future for communication systems making use of the tropospheric scatter principle.

Plans are now in hand to set up high power transmitters and associated receivers at Newcastle, on the north-east coast of England, and London, with the object of operating up to 36 simultaneous telephone channels between these two points (a distance of about 270 miles or 435 km approx.).

For the future, the ultimate limits of transmission will depend largely on the transmitter power available.

POPULAR SCIENCE QUIZ

Q: Oyster shells make quite effective houses for oysters but have you ever heard of them being used for human habitation?

A: According to overseas reports, Australian oyster shells are becoming quite a fad in the US as a decorative lining for interior walls.

The report says that the shells are soaked, flattened in hydraulic presses, burnished and trimmed. They are then attached to a base material with a special plastic adhesive. The panels are finally trimmed and smoothed over, ready for fixing to interior walls.

The report says that the panel can be formed to any desired shape by heat treatment or even used as an interior decorative trim for high-priced automobiles.

Largest single installation is in the Fontainebleu Hotel in Miami, while a room has been done in Prince Rainier's Monaco palace. President Eisenhower's personal plane also has an oyster-shell trim.

Q: How long would it take a person to count to a million, assuming he had the time and stamina?

A: It has been estimated that if a person could count at top speed, without a break, he could reach a million in about three days—a total of about 72 hours. Allowing time off for sleep and meals would extend the time to a week or more. If the target were a billion instead of a million, the time, even without rest, would extend to about eight years for an American.

A Britisher would never make it, because an English billion is usually regarded as a million-million, against the American practice of referring to a billion as one thousand-million.

Q: Speaking of billions, would it be an under-statement or an overstatement to say that there are "billions of molecules" in a teaspoonful of air?

A: It would be an understatement of the same general order as saying there are dozens of people living on earth. As a matter of fact, there are a couple of hundred million dozen people on earth.

The number of molecules in a teaspoonful of air amount to so many billions that the quantity can be much more aptly expressed in mathematical terms than in words.

Q: Coming back to everyday matters, is there any special advantage in using high octane fuels with an old model car?

A: Unless the car is very much "souped up", the answer to the question is most likely "no". High octane fuels are most valuable with motors having a high compression ratio, the latest American engines running as high as nine or 10 to one.

By using the right fuel and having the ignition set correctly, good mileage and general performance can be obtained from such a motor.

In a motor having a low compression, either by design or deterioration, the virtues of high octane fuel are largely wasted. Some reports indicate that petrol economy actually suffers, apart from which the higher octane fuel costs more in the first place.

Precise fuel requirements vary from car to car in the same model and even during the life of a single car.

Q: While on the subject of cars, what are the major arguments for and against the smaller wheels mooted for new cars?

A: There are actually many arguments for and against smaller wheels, some of them quite important. However, the strongest argument in favor of the smaller wheels is that they permit a lower overall height of the vehicle, making it more stable and in keeping with modern styling trends. Actually the gain in this direction is not spectacular, because smaller rims usually carry larger diameter tyres.

One of the chief problems at present is that conventional brake drums cannot go on shrinking with rim sizes, without losing their effectiveness.

This is a real problem with US cars in particular, which are tending to higher speeds with no reduction in weight.

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U or F30/150	230/240	30	150/150	6.3v/1.7a	Midget U or F
U or F40/150	"	40	150/150	6.3v/2a	Upright or Flat
U or F40/285	"	40	285/285	6.3v/2a 5v/2a	Upright or Flat
U or F40/325	"	40	325/325	" "	Upright or Flat
U or F50/225	"	50	225/225	6.3v/2a	Upright or Flat
U or F60/285	"	60	285/285	6.3v/2a 5v/2a	Upright or Flat
U or F60/325	"	60	325/325	" "	Upright or Flat
U or F60/385	"	60	385/385	" "	Upright or Flat
U or F80/285	"	80	285/285	6.3v/2a 6.3v/2a 5v/2a	Upright or Flat
U or F80/325	"	80	325/325	" " "	Upright or Flat
U or F80/385	"	80	385/385	" " "	Upright or Flat
U or F100/285	"	100	285/285	6.3vct/2a 6.3v/2a 5v/2a	Upright or Flat
U or F100/325	"	100	325/325	" " "	Upright or Flat
U or F100/385	"	100	385/385	6.3vct/2.5a 6.3v/2a 5v/2a	Upright or Flat
U or F125/285	"	125	285/285	6.3vct/2a 6.3v/2a 5v/2a	Upright or Flat
U or F125/325	"	125	325/325	" " "	Upright or Flat
U or F125/385	"	125	385/385	6.3vct/2a 6.3/5a 5v/3a	Upright or Flat
U or F150/285	"	150	285/285	" " "	Upright or Flat
U or F150/325	"	150	325/325	" " "	Upright or Flat
U or F150/385	"	150	385/385	" " "	Upright or Flat
U or F175/425	"	175	425/425	6.3vct/3a 6.3/2a 5/3a	Upright or Flat
U or F200/385	"	200	385/385	6.3vct/3a 6.3/3a 5/3a	Upright or Flat
U or F250/385	"	250	385/385	6.3vct/4a 6.3/3a 5/3a	Upright or Flat
*T80/265	"	80	265/265	6.3vct/2a 5v/2a	Upright

*Low Field Tape Recorder Transformers. Other types available on request.

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Have many quality features and possess the utmost in filtering properties. Using the latest winding techniques, and incorporating the best materials, they ensure and maintain the highest possible standard in overall performances. Ask your supplier for full details now.

NATIONAL POWER TRANSFORMERS. Manufactured by specialised factory employing the latest winding techniques and embodying the best materials consistent with modern practice. They are used exclusively by many of the largest radio manufacturers. Ask your supplier for full details now.

TYPE	INDUCTANCE in HENRIES.	mA	D.C. RESISTANCE
B.14/60	14	60	520
C.20/60	20	60	500
D.30/60	30	60	600
C.15/80	15	80	430
E.20/80	20	80	300
E.30/80	30	80	380
F.15/100	15	100	300
F.15/125	15	125	250
F.15/150	15	150	200
F.12/175	12	175	160
F.12/200	12	200	125
F.12/250	12	250	133

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Classroom TV

ENGLAND will soon repeat a system of teaching by TV now operating in Maryland (US).

There, two high schools and six elementary schools, with a total of 6000 pupils, are getting "piped" TV teaching at Hagerstown.

The scheme will be extended to another 15 schools this year.

By 1958-59 all the county school system, with 19,000 pupils, will be connected to the system.

With TV, there are no back-of-the-class pupils, for sets are dispersed at various points of the room.

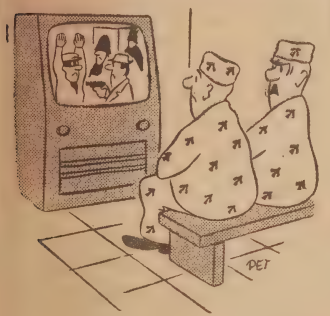
TV in Persia

THE Government has authorised a Persian firm to erect and operate the country's first television station, to be working in 1958.

The company will spend about £50,000 on the station to have a range of 30 miles.

Programs will be supervised by the Government, which operates Teheran Radio, and will pay between £12,500 and £19,000 toward program costs.

The company holding the television concession rights will also sell screen space to advertisers.



"I hate TV. Our side always loses."

More atom plants

SMALL atomic power plants for the production of heat or electricity can now be obtained in Britain. The equipment is of American design.

Power plants are available in three sizes, giving net electrical outputs of two, five and 10 megawatts.

There are plans to extend the range to 25 megawatts.

A 10-megawatt station, which could supply a community of 20,000 can be built on a site no larger than a tennis court.

Cost of installation is about £2-million, including hire of fuel.

Electric power units would be produced at around 1½d to 2d a unit.

Stations are based on a small pressurised water reactor, using light (natural) water as a moderator and coolant.

The reactor would run from 18 months to two years without change of the fuel elements.

Supply of fuel, on loan, has been guaranteed by the United States for the life of the reactor.

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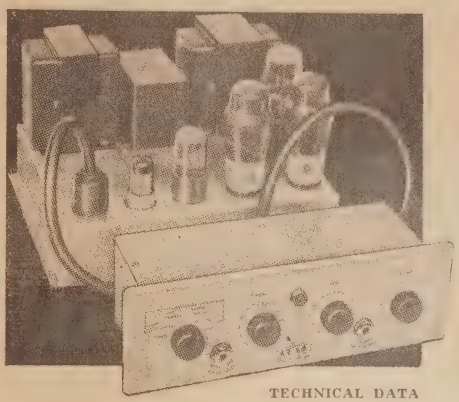


TECHNICAL DATA

LEAK

"POINT-ONE" AMPLIFIER AND PRE-AMPLIFIER

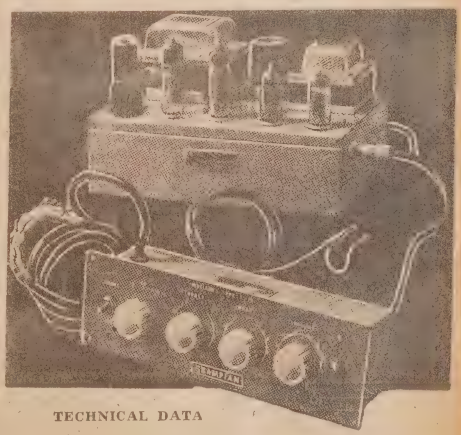
The Amplifier which sets a new high standard of fidelity all over the world. It incorporates the LEAK 3-stage triple loop feedback circuit with two high slope tetrode valves in the output stage. Two models are available: The TL10 for use in temperate climates and the TL12 which is ideal for tropical conditions.

Max. Power Output	10 watts.
Harmonic Distortion	Approx. 0.1% for 7.5 watts at 1000 c/s.
Hum and Noise	—80db referred to 10 watts + or —4db.
Frequency Response	+ or —1db, 30 c/s to 20 kc/s.
Tone Control	Continuously variable treble and bass: —9db to —15db at 10 kc/s —12db to —13db at 40 c/s.
Input Selector	4 seperate characteristics available, also provision for tape recorder (recording and playback).
Price Complete	TL10, £76/13/-. TL12, £124/19/-.

Write for details of the LEAK DYNAMIC PICKUP. Price £37/6/5 complete with two heads.

GRAMPIAN MULLARD

An amplifier which combines quality with economy by accepting reasonable limitations in the input and output stages. Based on the well-known "Mullard 5-10" and built by Grampian Reproducers Ltd. of England, it is intended for use with Crystal pickups. A separate unit carries all controls including volume, tone, input selector, mains on-off switch and pilot light. The high gain input stage is directly coupled to the phase splitter which feeds two pentodes in push-pull.



TECHNICAL DATA

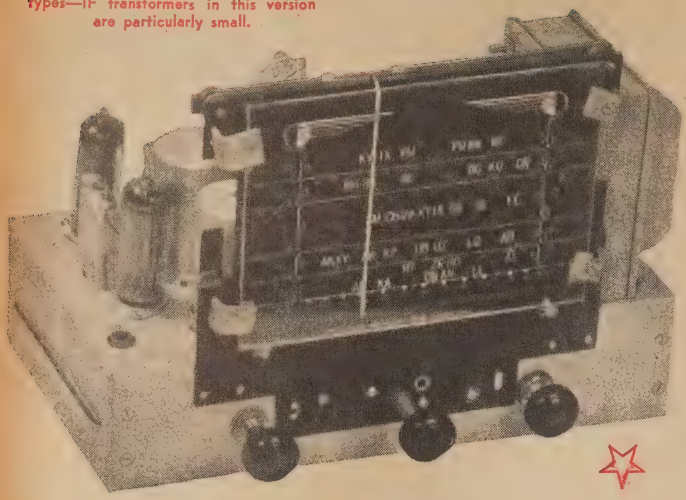
Chandlers stock everything for the Hi-Fi enthusiast—Amplifiers, Pick-ups, Speakers, etc., by the world's finest makers.

Max. Power Output	12-13 watts.
Harmonic Distortion	Less than 0.3% at 2000 c/s.
Hum and Noise	—73db relative to 10 watts.
Frequency Response	= 0.5 db 10 c/s to 20 kc/s.
Tone Control	Continuously variable treble and bass. —10db to —10db at 10 kc/s. —5db to 11db at 20 c/s.
Input Selector	3 separate characteristics available.
Price Complete	£53/16/10.

CHANDLERS Pty. Ltd.

Readers in Queensland, New Guinea and Northern N.S.W. are invited to write for full information of HI-FI equipment available immediately from:

Head Office and Wholesale Dept., Cnr Albert and Charlotte Streets, Brisbane. FA0341.



Aerial and oscillator coils are standard types—IF transformers in this version are particularly small.

Front view of the chassis built as a general purpose viewer. The volume control is at the left—tone control at the right—tuning in the centre.

Some New Thoughts On Small Receivers

The circuit described here has some features which, if they are not startlingly new, can be considered to bring our ideas on small sets up to date. It should be helpful to anyone who requires a simple method of making a general purpose receiver. Its output and power consumption can be varied by a simple alteration of component values.

by John Moyle

EVEN the most ingenious among us must admit that designing any kind of a receiver which will be radically new, or which introduces any revolutionary ideas, is a very difficult job.

There was a period in history when circuits used so many valves and components that it was always possible to whittle them down, to make one valve do the work of two or three, and in the process beat a path to the ultimate in simplicity.

SEARCH FOR SIMPLICITY

But things today are different. So many brains have stewed over the problem, and so many new valve types and components have been produced, that the seeker after something new finds himself treading suspiciously familiar ground each time he addresses himself to the problem anew.

The all-time high in simplicity was probably set by the "Little General"—a receiver thought out before World War II. It used a convertor valve, an IF stage using a diode-pentode and a single audio valve in the form of an output pentode driven directly from the diode detector.

It didn't even use AVC, and its total bits and pieces were less than a dozen.

It was probably the first of its kind, but since then commercial and home-built versions could easily number a million.

It used an IF of 455 Kc or thereabouts, a frequency which by that time had finally taken over from the earlier standard of 175 Kc.

And today, when we turn to small sets, it's very difficult to get far away from this circuit. After all, it can't be varied in great detail until we invent new ways of fitting more valves into a single envelope, or, better still, doing away with valves altogether.

Or some method of achieving suitable selectivity in a single step, operating a transistor-like device which gives adequate amplification with near-zero power consumption, and an audio section which is its own sound radiator.

The whole thing could then be fitted into a decorative plaque to hang on the wall, or even fit on your wrist like Dick Tracy's.

MANY IDEAS

The main advantage of Tracy's effort, of course, is that it was invented by some genius who didn't have to reveal his methods.

We, unfortunately, find it impossible to produce concrete results on the same principle.

And yet it is a subject we have to consider many times, for one of the most frequent requests we get is for a simple, straightforward circuit that can be used for a broadcast set — just that and nothing more.

Maybe someone wants to make up a bedside receiver to fit into some cabinet or other housing idea of his own. Perhaps he wants a set to sit on a shelf in the kitchen so that his wife can listen to serials in the daytime. He may even have a nice radio cabinet which he doesn't want to throw away, but which would be just the thing to take a straight receiver and drive a 12-inch permagnetic speaker which otherwise would continue to gather dust in the discard.

There isn't any reason why several of our past circuits should not be quite suitable in answer to such requests, and we often use them. The purpose of this article, however, is to re-state the requirements, and so present a new solution, which, if it does not differ in many ways from old ideas, at least has the virtue that it used what we think are the most useful all-round components.

In the matter of speakers and power output, opinions differ quite a bit as to how much wattage the average set needs for ordinary listening.

HOW MUCH POWER?

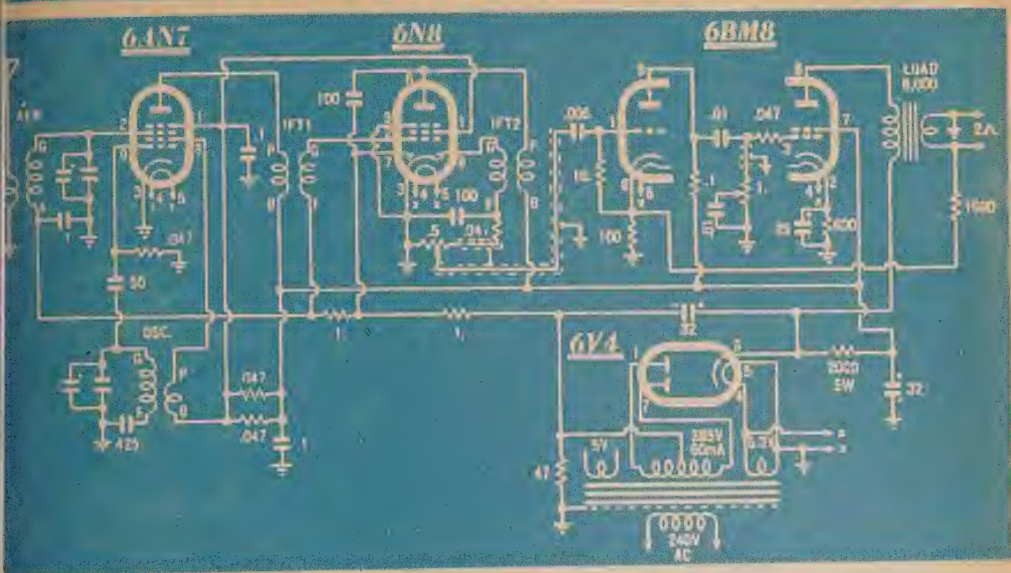
Even among members of our staff, when discussing a new circuit, there was considerable and heated discussion.

On the one hand it was pointed out that our everyday receivers are mostly overpowered, and that the average output requirements are not likely to exceed more than a hundred or two milliwatts.

This would make a figure of, say, 1.5 watts more than ample.

In many cases, particularly when we are considering small mantels, all this is quite true.

SAME CIRCUIT CAN BE USED FOR TWO VERSIONS



Circuit uses new triode-pentode output valve plus feedback. A high and a low output version is possible merely by changing a few circuit values. Performance is high for only four valves.

Few of us could endure a bedside set aring forth the latest numbers in an tempt to entertain us and the neigh- ors as well.

But as I see it, as soon as we have ccasion for more than average volume, e are in trouble unless there is reason- ble reserve available.

If we accept the rough and ready ule that a 3 db change is the least we an appreciate in the normal way, we iust double our power with a barely per- eptible increase in volume.

RANSFORMER EFFICIENCY

If we want to play the set a good deal ouder than normally, we could easily call or four or six times the ordinary figure. n fact why set a figure at all? Your uess would be as good as mine.

And if we remember that modern re- ordings, for instance, have considerable lynamic range, even when broadcast, and hat we must have many times the aver- ge figure to allow for peaks, I feel that t is a good thing to see that we have all he power we can reasonably provide.

With sets of a modest size, we are nlikely to use output transformers of nigh efficiency. Some of them might not be more than 50 or 60 pc efficient. In such cases, well-nigh half our available power might be lost on the way, so that it is very hard to think about power in accurate terms.

That is one reason we have worked out two versions of this circuit, one to make the most of what the output valve will give, and one which is a compromise between what we might require of a small receiver and the cost of compon- ents, remembering that 20/- is a worth- while saving in a job which doesn't cost a great deal in the first place.

If your ideas are limited to a small set, then the lower power should do you nicely. It is hard to make a case for any more.

But if you do have that 12in. speaker, old or new, which you plan to mount in a reasonable cabinet, or even if you want to hear good volume from a smaller one, the higher powered version would be best.

A set of this nature, being so often supplementary to others which are prob- ably in the house, should not be a major project to build. It should not have any critical or touchy features about it which will make it unsuitable for different chassis layouts. It should not use any more components than are strictly neces- cary, certainly not those which cost ap- preciable sums of money. It should be capable of being assembled in a very small space for those who want to make it a real midget, and equally suitable for fitting into a chassis which might be on hand, perhaps already fitted with a tun- ing capacitor and dial.

It need not produce great amounts of power, for it is not usually required as a radiogram or hi-fi installation. Its pur- pose in life is more modest, but it should do its job well.

It should produce with ease all the local radio stations, and a few others further away, but is not required to tune in Alaska or to cover the short-

PARTS LIST

1 285/285 60mA power transformer
1 USL/44 dial.
1 2-gang miniature (AWA)
1 Standard aerial coil
1 Standard oscillator coil.
2 455Kc miniature IF's.
4 Noval sockets.
1 Miniature 4-pin plug and socket.
2 Trimmers.

VALVES
1 6AN7, 1 6N8, 1 6BM8, 1 6V4.

RESISTORS
1 10 meg ½watt.
2 1 meg ½watt.
1 .1 meg ½ watt.
3 .047 meg ½watt.
1 1,500 ohms ½ watt.
1 100 ohms ½ watt.
2 .047 meg 1 watt.
1 560 or 600 ohm 1 watt.
1 47 ohm 1 watt.
1 2,000 ohm 3 watt.
1 .5 meg potentiometer.
1 1 meg potentiometer.

CAPACITORS
1 .1 mfd 400 volt paper.
2 .1 mfd 200 volt paper.
1 .01 mfd 400 volt paper.
1 .01 mfd 200 volt paper.
1 .005 mfd 200 volt paper.
1 425 pf mica.
2 100 pf mica.
1 50 pf mica.
2 32 mfd 350 volt electrolytics.
1 25 mfd 40 volt electrolytic.

SUNDRIES
3 knobs, 2 termials, nuts and bolts, sol- der lugs, hook-up wire, tinned copper wire, spaghetti, shielded hook-up wire a length of 3-core power flex and power plug, 2 7-lug strips, 1 4-lug strip, 2 2-lug strips, 2 dial lamps.

STAR BARGAINS

HOMECRAFTS FOR LOUD-SPEAKERS

We recommend the following—

	Frequency Response	Watts	Impedance	Price
Rola Hi-Fi 12UX	40-14,000 C.P.S.	20	15 ohms	£28/19/5
Rola 12UX	45-12,000 C.P.S.	12	8 "	£25/17/2
Rola 12OX	45-12,000 C.P.S.	6	2 "	£10/2/7
Rola 12O De Luxe	60-8000 C.P.S.	7	2 "	£5/17/6
Jensen Dual-Concentric	40-12,000	20	15 "	£17/12/3
Jensen 2-speaker System	50-10,000	20	15 "	£8/19/6

CONDENSERS

Assorted Tubular 600 volt types — 6d each or 5/- doz.
.001 . .002 . .003 . .005 . .006 .

Electrolytic types
8/350 .. 1/11 ea.
16/350 .. 2/11 ea.
16/525 .. 3/11 ea.
14/600 .. 4/6 ea.
300/12 .. 5/- doz.
10/40 .. 1/- ea.

DUAL TYPES
8 and 8/525 .. .. 4/11 ea.
8 and 16/525 .. .. 5/11 ea.

DIAL LAMPS

6 volts, 250mA, M.B.C. base, 6d ea. 4/9 Box of 10.

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Suit 6in speaker .. .. 1/11 ea.

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The Capitol

4-WATT AMPLIFIER

£14/19/6

3-SPEED RECORD PLAYERS

Latest Model Collaro £12/15/6
B.S.R. HF100 .. .. £13/5/-
Philips AG2002 .. .. .. £12/15/-

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1mm .. .. 4d yd.

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½ meg. Switch Potentiometers
4/11 each.

Speaker Transformers
8000 or 10,000 to 3.7 ohms, 3/11 each

Assorted Speaker Windings,
20/- dozen

20-Watt Woofers,
16 ohms Voice Coil.
well-known make.
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12-Watt Hi-Fi Speakers.
Local make, 12in twin cone. Frequency Range, 45/12,000 C.P.S., 19 gns.

Record Changers.
3-speed Collaro.
Superseded model
£11/19/6

Resistor Substitution BOXES

Valuable aid to the serviceman. Covers from 25 ohms to 10 megohms.
79/6 each.

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1200ft 7in spool paper base . 30/-
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HOMECRAFTS FOR TV SPARES

Chassis suit 17in tube .. .. 10 gns. Complete with brackets, etc.
Line and E.H.T. chassis assembly, £26/8/1
IF strip assembly £22/2/3
Turret tuner assembly .. £27/19/6
Deflection and focusing assembly, £11/7/9
Full stocks of other TV components always in stock.

Goldring No. 555 Variable Reluctance Cartridge, .. £6
Goldring Transcription Arm, will take any Cartridge with ½" mounting centres .. £7/10/0
Goldring Lenco Transcription Motors and Turntables .. £30
Goldring 3-speed Motors and Turntables — MU14, £7/15/0
Goldring - Monarch Record Changer, in Leatherette Carrying Case £27/19/6
Collaro Transcription Motor and Turntables—2010 less pickup £26/7/6
Collaro RC54 Record Changer £22/7/6
Collaro Plug in Pickup Head C/W type "O" Turnover Cartridge .. .. 5gns.
Collaro Plug in Pickup Head. C/W GP27 Cartridge — L.P. or Standard 75/-
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6 volts, 4 amps .. .. 59/6 ea.
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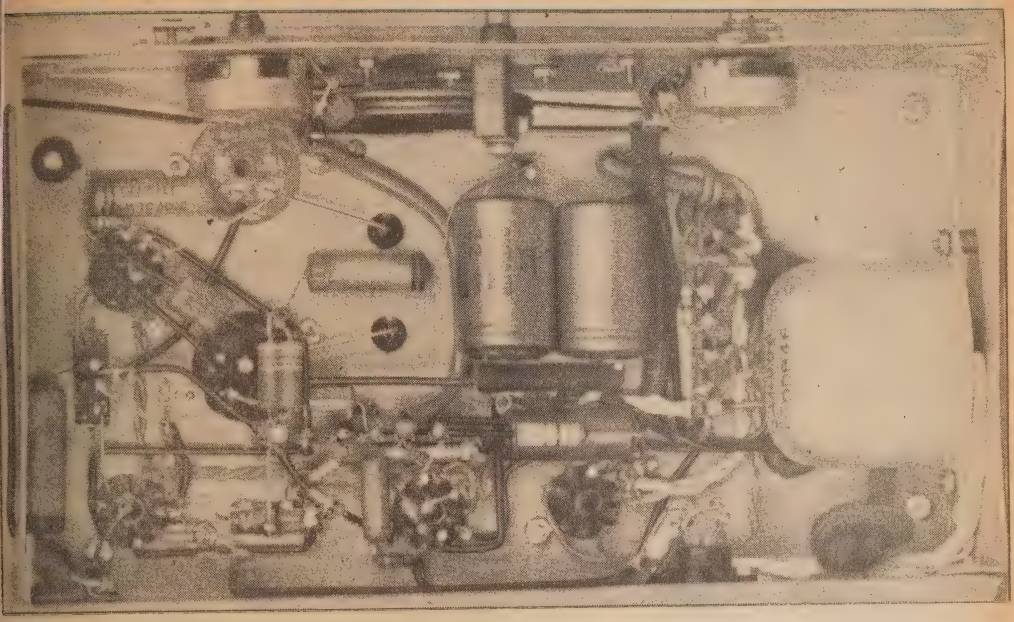
Black Crackle Chassis,
5, 6 or 7 valve .. .. 8/11 ea.

INSPECT HOMECRAFTS HI-FIDELITY CENTRE

The best of everything in Hi-Fi equipment.
See and hear the famous
Leak
Quad
Williamson Amplifiers.
A large stock of cabinets is available for mounting above amplifiers in addition to motors, pickups, control boxes, etc.
Speaker enclosures of all types also available from stock or to special order.

LAYOUT ALLOWS SHORT DIRECT LEADS TO COILS



Layout has paid special attention to shortest possible connecting leads in RF circuits. The 6AN7 is situated equidistant from both aerial and oscillator coils for this purpose. Note the small rectangular outline of Philips IF transformer. Both core adjustments are made from above the chassis. Speaker transformer is at the right

wave bands or to separate the 200-odd stations we have in Australia. Nor should it require anything elaborate in aerials —20ft of wire on the picture rail or around the skirting board should be enough for everyday results.

So here it is—just a good workhorse of a circuit which you can put together to suit yourself.

Naturally it isn't possible for us to physically build up several shapes and sizes of chassis in the hope that one of them will suit your needs. We don't know just what these will be. The chassis shown here is just an ordinary thing which you can take as a guide if you like, and which will illustrate a few points in layout which should be kept in mind with any receiver.

You could put it into a small cabinet just as it is, with a speaker at the side, or on top, or elsewhere in a larger cabinet. You could even push the power transformer to the rear, use a smaller dial, and mount a small speaker on the chassis as we have done many times.

OUTPUT STAGE

Its main purpose is to illustrate the set in one of the many forms it could take with equal success.

The most interesting feature of the set is probably the output stage. It uses a new triode-pentode valve which has lately been placed on the market and which is very popular in the output stage of TV receivers. It hasn't anything to do with TV as such, of course, and can be used just as well here. We used it in a handy little amplifier circuit described last month, and which, like this one, was intended as a general purpose job capable of standing in for a variety of purposes.

The 6BM8 has a high-mu triode section which makes a good voltage amplifier, and a pentode output section capable of producing 3.5 watts into the transformer primary with a plate voltage of 250 volts, a bias of 20 volts and a maximum cathode current of about 33 mills.

It has also a number of lower voltage ratings, more specifically in relation to the screen, which allow the smallest of power supplies in general use, and a still lower current drain.

IF STAGE

It is a more useful valve than the single output types we have previously used in sets like the Little General, because the triode voltage amplifier gives it just that extra amount of gain which makes the difference in practice. There is even enough for us to use a modest amount of negative feedback, something new for us in small sets.

In our opinion, this valve makes a very worthwhile contribution to the task of providing a better circuit.

Another interesting point is the use of the new Philips miniature IF transformers which are particularly useful where space is at a premium.

Our chassis layout allows any of the normal, square-can IF's to be fitted in, and they are just as suitable for it as any other. We used the Philips because they are new and novel, and have their own advantages of extra small size.

You will find the side-by-side arrangements of the connection pins useful, too, in arranging for short leads to grid and plate pins of the valve sockets. As the transformers have a very high gain, this is quite an important point in avoiding regeneration due to unwanted coupling in the set wiring.

Yet another unusual feature is the omission of the filter choke in the power supply.

Although we would not be happy with any circuit which allowed an appreciable amount of hum, we realise that the requirements in this connection need not be as stringent as we would demand in a big amplifier or radiogram, where efficient speaker mountings tend to show up the slightest tendency to filter hum.

We thought it a good test to connect up an efficient 8in speaker and to note that it was necessary to hold it a matter of inches away from an ear to hear the hum at all except perhaps in a dead-quiet room.

When any kind of music is playing, the hum wasn't even audible.

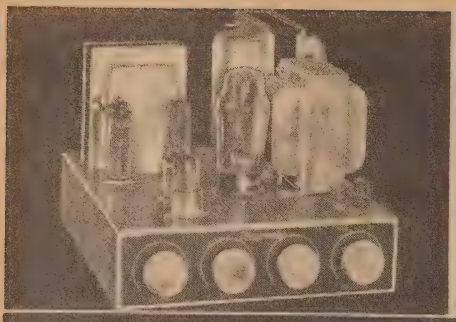
HUM LEVEL

Feeding it into an old K12 speaker we had in the lab. mounted on a 3ft baffle, the hum level, if anything, was even less apparent.

You will see that there is a filter choke mounted on the chassis in one of the photographs. It was placed there during some experiments with power supply arrangements, but we were finally satisfied that it could safely be eliminated.

Its presence, too, made the distribution of voltages rather difficult in working out operating conditions for the output valve.

The 6BM8 must operate with a slightly lower screen voltage than does the



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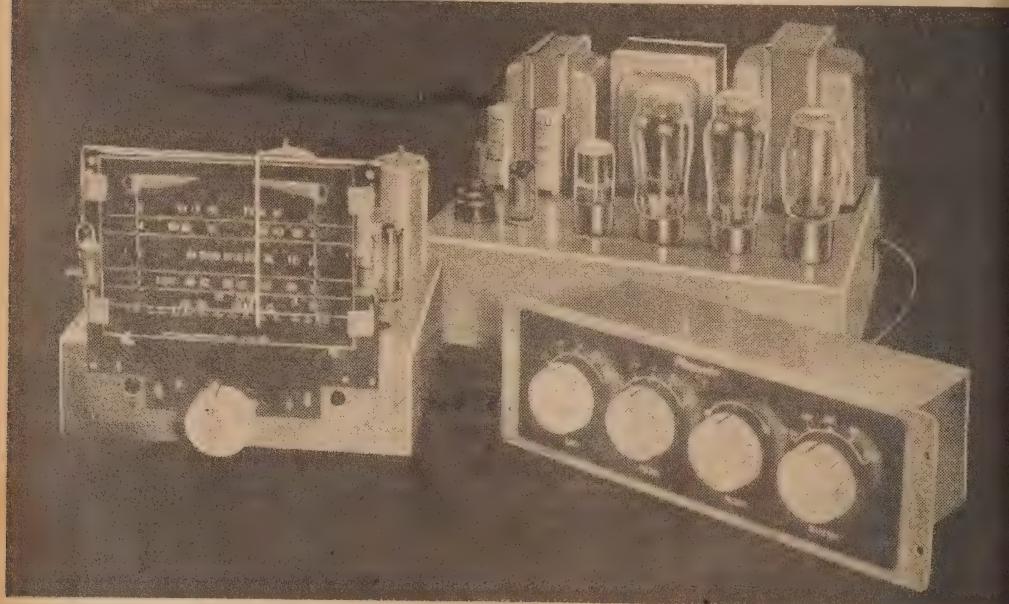
If you prefer to build your own hi-fi gear, we can supply the kit of parts containing precisely the same high-grade components as are in the completely built unit. Below are a few of the latest Playmaster designs.



Playmaster, Australia's Own Hi-Fidelity Sound Equip.

- 20 Watt Ultra Linear Amplifier— for magnetic or crystal pickups.
- 17 Watt Ultra Linear Amplifier— for magnetic or crystal pickups.
- 10 Watt Ultra Linear Amplifier— for magnetic or crystal pickups.
- 5½ Watt Ultra No. 13 Amplifier —for crystal pickups.
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for maximum output, not because reen limitations, but because other- we would exceed the permissible dissipation with desirable levels of

we were to use a filter choke, h has several hundred ohms resist- , we would not be able to arrange the 3.5 watt condition without add- extra filtering, which costs money which we wanted to avoid.

, using a large first filter condenser running the output plate from the fier cathode, we can make the most vailable voltage. By using a resist- in the filter circuit instead of a ke, we can arrange the necessary in screen voltage, and at the same feed the remaining plates from this t.

ne extra dropping resistor looks after RF screens.

WER SUPPLY

ll this filtering, therefore, is accom- ied with two electrolytics, two re- rs and the normal screen bypass on first two valves.

he same circuit connections are used a lower output version, which would the one to select if you wanted a ll mantel set.

he only difference is in the use of a ller power transformer, two resist- e values, and a resultant output of under two watts into the trans- mer primary with a lower current in.

The higher output is obtained with 285 volt 60 mills transformer, which es 250 volts for the 6BM8 plate. A ter" resistor of 2000 ohms is used drop the voltage to 235 volts for the M8 screen and the remaining plates. third resistor of about 22,000 ohms uces the voltage to about 85 volts the screen of the 6N8 and the N7. The current drain of the 6BM8 then 33 mills, and of the set 50 mills h signal. The output bias is 19 volts. load of 8000 ohms is needed for the tput transformer—in practice 7000 il do.

The lower output circuit uses a 225 lt 50 mill transformer, which gives effective 6BM8 plate voltage of 240 lts. The "filter" resistor is 6000 ohms, hich gives 140 volts for the 6BM8 reen and the plates of the other two lves. A further resistor of 10,000 ms gives the necessary screen voltages r the RF valves. The 6BM8 cathode rrent is 28 mills, the total drain 45 ills and the 6BM8 bias is 10 volts. A ad of 12,000 ohms is required for the eaker transformer.

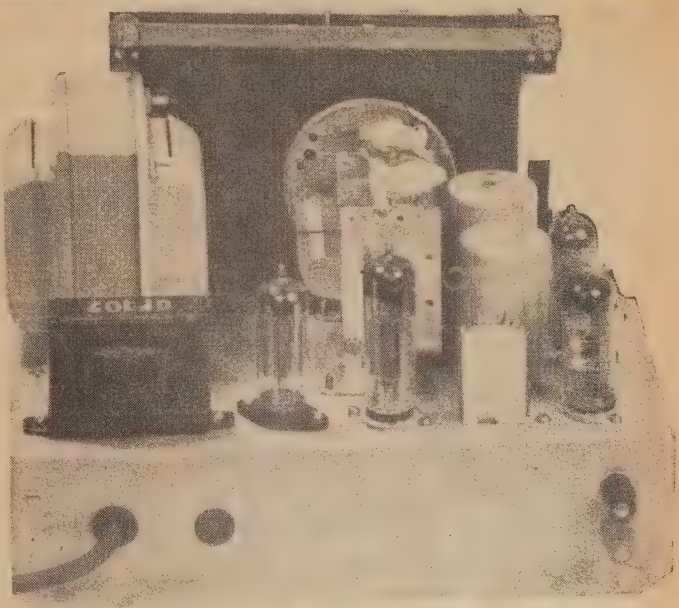
EEDBACK

No other changes are needed from ne version to the other.

In both cases the negative feedback about 12 db, which is a very useful gure in reducing distortion, reducing am level and lowering output imped- nce. It is suitable for the small output ansformers likely to be used without anger of instability, providing that the ansformer used is mounted somewhere n the chassis to avoid long leads.

In the low-powered version, you will ote that the plate voltage for the RF alves is only 140 volts. This is quite nough to give ample amplification from hese valves, although not quite as much s that obtainable from the higher volt- ge. The difference in sensitivity will ot be noticed in practice and, in any

A REAR VIEW OF THE CHASSIS



The filter choke shown here was experimental—not used in final circuit. If the power transformer is moved back a small loud speaker could be placed alongside the dial. Trimmers are mounted directly on the gang. If transformers are held in place by spring clips.

case, the small receiver is not likely to be required with maximum sensitivity.

Within reason, variation in plate voltage over quite a wide margin does not materially change the amplification of these valves.

AVC is applied to both mixer and IF valves, and for simplicity their standing bias is obtained from a back bias resistor.

OUTPUT BIAS

We did not use this method for biassing the output valve, as experience has shown that extra filtering is often needed to avoid hum troubles, and it is much better to use separate bias at this point. In any case, the bias will be subtracted from the total high tension, and so both methods are even on this score.

Strictly speaking different voltages are needed for each screen and for the oscillator plate of the RF valves, but this is only important where maximum gain and isolation between circuits is desirable, such as might be the case in a high-gain dual-wave receiver.

There is virtually nothing lost for our purpose by running them all from the same point, as long as at no time with or without signal does the voltage exceed any one of the figures set down as the allowable maximum.

We have looked after this point in selecting resistance values.

The tuning coils and tuning condenser are all standard types. You will notice that in this particular layout we have arranged the front end to give the shortest possible leads connecting the gang, coils and valve pins. We have also taken care to see that the IF channel has no long leads, and that they do not perform any awkward "doubling back" which may bring them too near the input circuits.

Note, too, that the aerial lead runs directly away from the rest of the wiring, and is conducted along the outside of the chassis to the aerial terminal to avoid any coupling into previous circuits.

The leads to the volume control and to the tone control are made with earthed braided wire and are kept as clear of other wiring as possible. Most of the small resistors and other components are connected either directly to the various pins on valve sockets and coils, or to resistor mounting strips bolted to the chassis. We used direct point-to-point wiring in most cases to keep short leads and make rigid wiring.

THE LAYOUT

No matter what layout you use, you would be well advised to keep strictly to this progressive, straight-line method in which all the wiring, valve sockets and coils are arranged to keep the signal moving along a single path from input to output, with no doubling back or feedback paths from input to output. It is the most important rule for maximum stability.

Philips have pointed out to us that these tiny IF transformers have extremely high gain and good selectivity, and in some cases it might be a good thing to load one or both primaries with resistors if there is a hint of instability on no signal conditions.

We had no trouble of this kind, but

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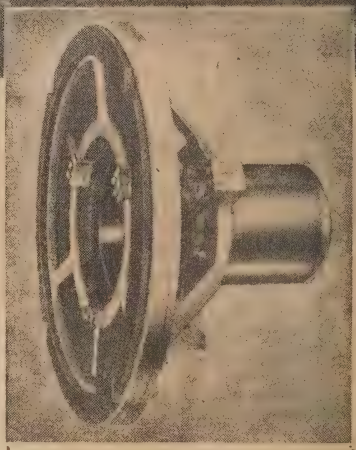

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tip is worth remembering with any dern IFs, all of which are designed l up the performance curves.

Resistors of about .1 megs or .05 gs would do, but they should not be d unless necessary. If you find in- ility in any receiver, best look for cause in layout or wiring before pting other cures.

Incidentally, a point not mentioned so is the circuit for the triode voltage plified, which works very well and es some components.

Normally, such a valve would use a hode bias resistor and bypass, or have grid circuit returned to the back bias work.

Both these can be avoided by using large value of grid resistor returned ectly to the cathode.

There is a small voltage drop across s resistor, due to contact potential cts in the valve, and this voltage is ch that the grid is held negative with spect to the cathode.

Thus we get the small amount of bias cessary for the valve completely free d for nothing.

As a matter of fact, according to the aker's specifications, the figures for dis- rtion for the triode unit are slightly tter with this method of bias than for e more common cathode bias circuit. here would probably be little to choose this respect—we used it because it ved components.

The makers specify a 20 meg resistor, t we used 10 megs because higher lues are often hard to obtain and may variable in accuracy. Provided the sistor is of this general order of value, sults will be much the same.

The voltage developed across the feed- ack resistor is not available in the form f bias, as the grid return is made direct the cathode. Nor does it affect the peration of the valve.

We have not provided connection for pick-up with this circuit, for several easons.

In the old days, adding a pick-up to a t consisted of switching a crystal type nto the input circuit of the audio end, o that the volume control was included, nd leaving it at that.

To a certain extent this is permissible oday, and it is often seen in commercial ractice. But whenever possible we like o take a little more trouble.

And in these days of realistic record- ngs and hi-fi, most people want very nuch more volume for their records han the average radio set can provide.

CRYSTAL PICKUP

Hitching a crystal pick-up to any re- eiver of modest output and speaker com- plement is often a short way to disap- pointment.

It would be quite simple to add a couple of pick-up terminals to the rear of the chassis so that a crystal could be slipped in at the top of the volume con- trol in the usual manner, but we have as- sumed that the majority of uses for this circuit will not include a radiogram.

We can suggest many much better ideas for your records.

But by all means try it, if you wish. It might even be possible to fit a switch to throw the pick-up in and out of cir- cuit, so that you don't have to remove the familiar bridge wire each time you use it.

This is another matter in which you can please yourself.

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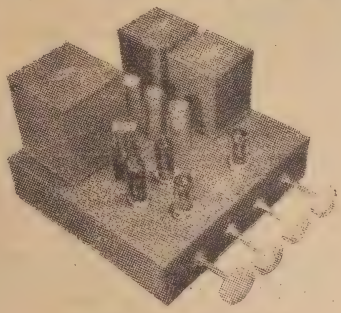

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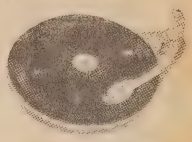

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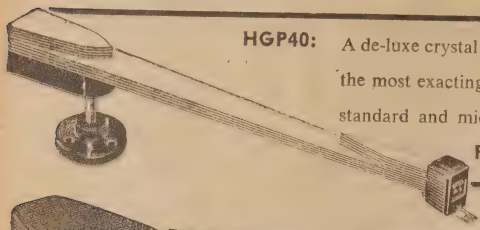
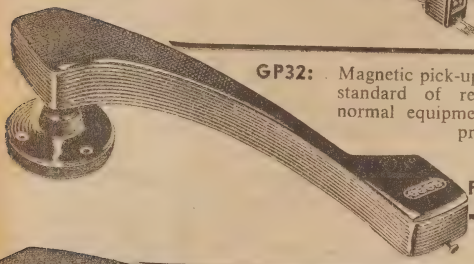
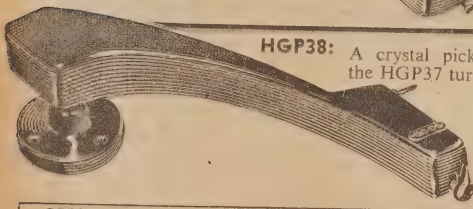


HGP40: A de-luxe crystal pick-up to satisfy the most exacting. Complete with standard and microgroove heads. **PRICE, £9/15/-**



GP32: Magnetic pick-up provides a good standard of reproduction with normal equipment at reasonable price. Output voltage, ½ volt at 1,000 c.p.s. **PRICE, £2/12/6**



HGP38: A crystal pick-up. Incorporates the HGP37 turnover cartridge for standard or microgroove recordings with cantilever stylus. **PRICE, £5/15/-**

GP50: Is a HIGH-OUTPUT crystal pick-up suitable for reproducing standard and microgroove records through *low-gain* amplifiers as used in small record players and some radios. **PRICE, £4/19/6**

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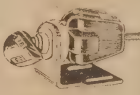

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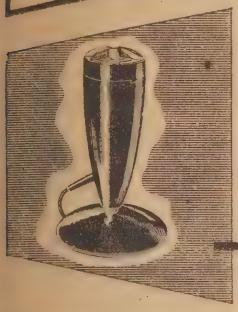


DESK or HAND MICROPHONE, MIC36

This Microphone is ideal for home recording and public address, etc. Response unexcelled for its size and price. The performance is not affected by vibration, shock or low frequency wind noise. Omni-directional frequency response substantially flat from 30 to 7,000 c.p.s. Recommended load resistance not less than 1 megohm, dependent on low frequency response. Can be supplied complete with switch and floor stand adaptor, as required, at a small extra cost. **PRICE, £6/18/6.**

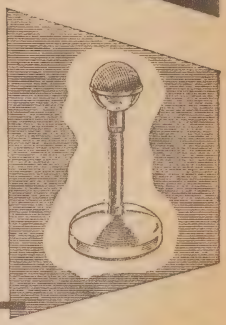
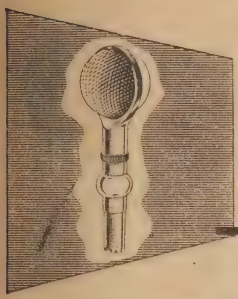


TABLE or STAND MICROPHONE, MIC22

This omni-directional Microphone is robust in construction, with a pleasing appearance. Vibration, shock or low frequency wind noise will not affect the performance. The low frequency cut-off is dependent on the load resistance. The cut-off is given by the equation, F = 80 divided by R, where F = c.p.s., R = megohms. An adaptor (floor mounting) is available at low extra cost. **PRICE, £9/18/6.**



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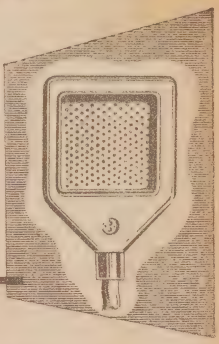
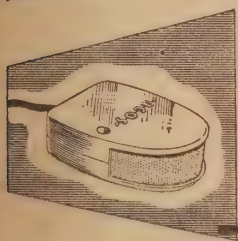


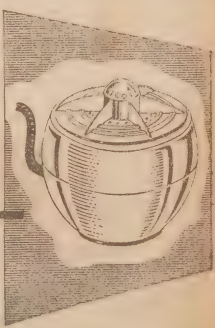
LAPEL MICROPHONE, MIC28

Designed to give freedom of movement, this Microphone is small and non-directional. Housed in a soft, moulded-rubber case, which gives protection against shock, it is provided with a pin at the rear of the case for pinning to the lapel. **PRICE, £5/19/6.**



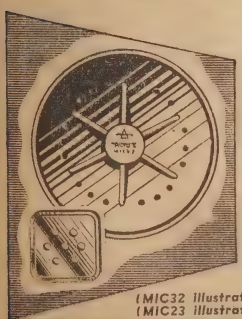
GENERAL PURPOSE, MIC35

The MIC35, is ideal for amateur transmitters, public address, etc. Housed in an attractive die-cast case, it features a high sensitivity and substanially flat characteristics. Provided with a built-in shunt resistance of 2 megohms, it will, when connected to the grid of the input valve, give a substantially flat response from 50 to 5,000 c.p.s. **PRICE, £2/15/-.**



HAND or DESK MICROPHONE, MIC33

This Microphone has been designed for the high quality public address and home recording field. High sensitivity and flat characteristics are obtained by a specially designed acoustic filter. Housed in an attractive plastic case with an unexcelled response for its size and price. Unaffected by vibration, shock or low frequency wind noise. Omni-directional frequency response substantially flat from 30 to 7,000 c.p.s. **PRICE, £6/18/6.**



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(MIC23 illustrated)

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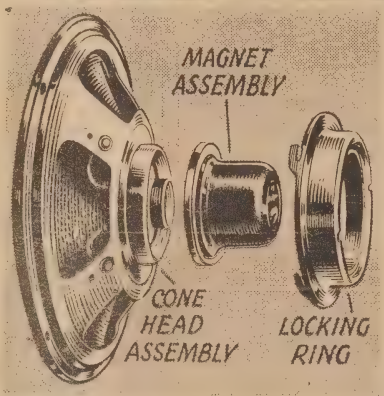

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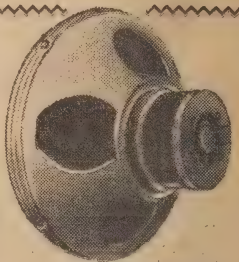

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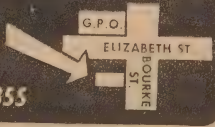

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Here's your answer, Tom!

Tom, this month, is faced with the familiar problems which have worried beginners since many of us were in short pants. Most of the questions have to do with regenerative sets, Reinartz coils, RF chokes and such like.

I have a three-valve regenerative receiver and when I tune to any station I usually get another station in the background. What can I do to eliminate this effect?

This sounds more like an attempt to ing in an "Answers to Correspondents" uestion, Tom, although it is certainly nore interesting to talk about than the sual. "My set won't work, what's wrong vith it?" approach we have to face so ften.

First of all, we assume yours is a tandard "detector and two audio" hook-ip.

If so, the basic reason why it fails to eparate stations is that it contains only ne tuned circuit.

The most successful tuned circuit from a selectivity point of view is one having a very high "Q". Without explaining this in general detail, we would say that such a coil has a much greater response to frequencies to which it is tuned than to those nearby. The higher the Q, the sharper will be the tuning.

Now to this coil we have to couple an aerial, and we must use a reasonable length of wire, otherwise we won't pick up enough energy for loud signals. Unfortunately, the coil sees the aerial as a resistance (or, more correctly, an impedance), which is wired directly across all or part of it, according to just how the aerial is connected. Now, one way to reduce quite drastically the Q of a coil is to start wiring resistors across the windings, particularly when their value is comparatively low as compared with impedance of the circuit itself.

COUPLING AND Q.

It follows, therefore, that the more tightly we couple the aerial the lower the Q and the poorer the selectivity. So we have to strike a compromise between signal strength and selectivity when connecting the aerial.

In a regenerative set we have a very potent method of improving the selectivity by the use of the reaction or regeneration control which feeds back energy from the plate to the grid circuit. This energy offsets the losses in the tuned circuit and thereby increases the Q again. Oscillation occurs when the fed-back energy is just able to overcome these losses. At this point the set has both maximum gain and maximum selectivity.

Except when listening for Morse code we can't operate the set right on oscillation because there will be some distortion of signals and a danger of the oscillating detector interfering with other listeners. We need a good coil in the first place, together with the right amount of aerial coupling and regeneration to give good signals with best station separation.

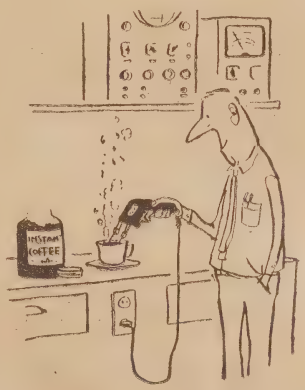
In your case, use the least aerial coupling you can to lessen the damping on the coil, and as much regeneration as you can without distorting signals or getting too near the point of oscillation.

★ ★ ★

I have noticed a number of circuits using a single 3V4 or similar with 9 volts high tension applied. Would anything drastic happen if these sets were used with a 45 or a 67.5 volt battery?

Only if you consider such things as a ruined valve or a run-down battery as drastic occurrences!

It works out this way: When the valve has only 9 volts applied to its plate, it will not draw much plate current and there is no need to limit it by using grid bias. If you merely increase the plate volts with such a set, the plate current starts to soar, particularly if the



—Radio Electronics

single valve happens to be a power valve, as in the case under discussion.

The 3V4 would draw almost 7 mA with a 45 volt battery, and almost twice that amount with a 67.5 volt battery. This drain would keep all but a large "B" battery fully occupied, and its length of life would be no greater than if it were running a 5-valve superhet.

With the higher plate voltages, the valve itself will be inclined to curl up its toes, because its maximum current is given as only 12 mills, and you would have considerably exceeded this figure.

When a valve is used as a grid detector it does not normally use external bias. Therefore, to keep the plate current within reasonable limits it is necessary to set a limit on the plate voltage.

However, as an amplifier valve it should have bias on the grid, both to keep the plate current within limits and to ensure distortion-free amplification. To discover the order of bias necessary for any particular valve and operating voltage, it is necessary to consult a valve data chart. If the valve chart is above your head we suggest that you follow an approved circuit.

For the time being, you keep to that specified 9 volts. It will be cheaper in the end!

★ ★ ★

I have just completed a one-valve receiver with some success, but when I open the reaction capacitor right out, the set develops a terrific howl which I cannot stop. At night I can just hear amateur stations through this howl. The circuit is a standard regenerative one, but I am using 45 volts instead of 9 volts high tension. Can you set me on the right track?

We certainly can, Tom; in fact, we already have, to a certain extent, in the preceding paragraphs on regenerative sets. Your case clearly demonstrates the need for a beginner to follow to the letter specifications given in a design.

The use of 45 volts as the high tension supply is probably forcing the detector to the point of super-regeneration, hence the howl at audio frequency. This condition makes it almost impossible to receive useful signals, although as you have found, some of them may be heard but in a mutilated form.

A modest plate voltage is almost a necessity to obtain smooth and controllable regeneration.

We suggest that you revert to the high tension originally specified, and do some experimenting along the lines indicated in the preceding paragraphs.

★ ★ ★

Are shortwave Reinartz coils available commercially? And if so, where?

We hesitate to answer questions along these lines because as sure as we say "No" someone will bob up with the information that so-and-so has been selling them for years.

However, that is the plain truth. As far as we know, shortwave Reinartz coils are not available commercially. The reason is that they are so easily hand-wound that the ultimate demand for them makes it hardly worthwhile for the manufacturer to add them to his catalogue.

They are generally wound with solid enamelled wire and the home constructor can wind a coil just as efficiently as an expensive machine.

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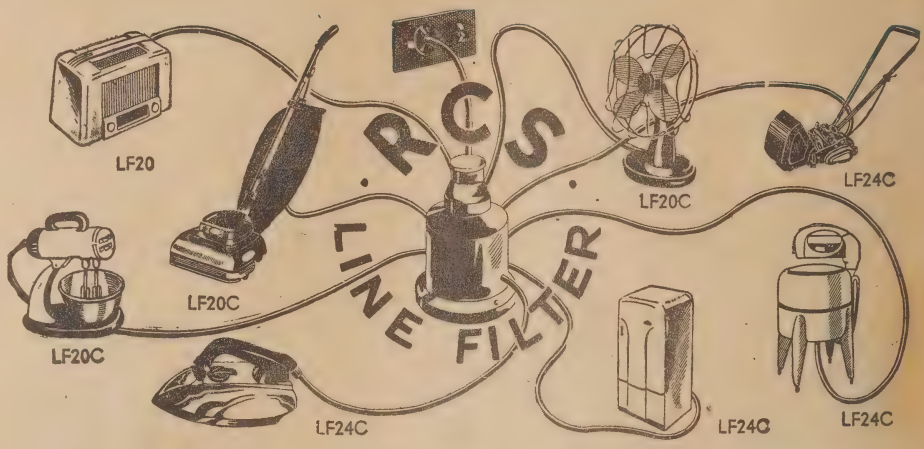

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We have frequently published coil data for reaction sets, but can always supply a specimen sheet of coil winding data through our two-shilling query service.

★ ★ ★

In a one-valve regenerative receiver recently completed I left out the RF choke. The results were splendid and I wish to know why this choke was specified.

So that you don't lose faith in humanity, Tom, we hasten to assure you that there is no tie-up between the publishers of a radio magazine and the manufacturer of radio parts. We don't specify parts in our circuits unless we think they are important.

This instance may be analogous to the choke in a motor car. The driver may get to work under the bonnet and emerge with a handful of levers and screws which constitute the said device. Then he may slide proudly into the front seat and drive away, pleased at having got rid of a superfluous gadget, thereby simplifying the mechanical layout.

The imprudence of his action would only be evident the next time he tried to start the car on a cold morning. The choke was there for just such an occasion.

In the one-valve reaction set in question, and in many others, the RF choke is included in series with the detector plate lead to prevent the RF component from being absorbed in the audio circuitry.

Whether the choke is necessary or not depends on such things as the length of the associated wiring, the sensitivity of the audio section to RF currents, and the amount of RF feed-back the detector requires to produce sufficient and smooth reaction.

Since all these are random or variable quantities, the omission of the RF choke may mean nothing in one set, but everything in another.

These remarks may be also applied to bypass capacitors, which may in some cases appear to be unnecessary in some sets, but the omission of which may cause instability in the form of unwanted regeneration in others.

A designer has no alternative but to specify the combination of components which experience has shown necessary to ensure a uniform performance in all cases.

Perhaps this may cost you a shilling more, Tom, but it is better than taking risks with the design and falling into difficulties.

★ ★ ★

I am enclosing one of your circuits. In it the negative side of the 250-volt power supply is connected directly to the earthed chassis. I should think that anyone touching the chassis would receive a good shock. Would you please explain?

Well, Tom, the negative side of the power supply is connected to the chassis in all our circuits, excluding those of special design and those requiring back bias arrangements.

The fact is that to receive a shock it is necessary to come into contact with two points having a difference of potential. Since the receiver chassis is at earth potential it is impossible to receive a shock when coming into contact with it, since your own body is normally at earth potential also, or if you have rubber soles, it may be at a "floating" potential.

The positive high tension line is a point of high potential, whilst the negative side or the chassis is assumed to be at zero potential with respect to the positive line. In actual fact, the chassis may be a few volts above earth due to a lack or inadequacy of earthing, but not enough to be serious.

And so in order to get a shock, you would need to touch both the chassis and the high tension line, or to touch the high tension when your body was "earthed" as well as the chassis. One way or another the circuit must be complete.

By earthing the chassis because it is connected to the negative pole, you are really protecting yourself against shock.

★ ★ ★

If back bias is built up across a resistor, why doesn't it upset the operation of the other valves since the current they draw also flows through this resistor?

If we wished to be facetious, we could say that the "other" valves never get to know about the back-bias resistor.

The back-bias resistor is so placed that it makes available a voltage negative with respect to earth, because of the voltage drop caused by the entire set current which flows through it. The most negative point along this resistor is, of course, the centre tap of the secondary, and the least negative point is the chassis.

The bias voltage for a valve must be applied between the grid and cathode. If both points are returned to earth, there won't normally be any bias.

But, if the cathode remains earthed, and the grid return lead connected to the top of the bias resistor, the valve will be biased by the negative voltage at that point.

If a second valve needs only half the bias applied to the first valve, its grid return can be tapped halfway along the bias resistor—if one-third of the bias is enough, then the tapping goes one-third of the way along.

Thus, it is the point of grid return which determines the actual bias applied to the valve.

★ ★ ★

In some of your circuits back-bias is used for all the valves. If cathode resistors were added to some of the valves, would it increase the bias on these valves?

It certainly would, because bias may be applied to a valve in the form of negative voltage at the grid or positive voltage at the cathode. If a valve is operating with, say, minus 3 volts bias on the grid, and you were to add a resistor in the cathode circuit which raised the cathode another 3 or 4 volts positive, this would be equivalent to adding another 3 or 4 volts to the grid bias, producing about 7 volts in all.

In RF or IF stages this would tend to reduce the gain drastically. In an audio stage overbiasing could lead to distortion.

★ ★ ★

Recently I built a 5-valve receiver which works quite well, but I find that its sensitivity increases if the AVC line is shorted to earth. Should this be so?

Not if the set is operating at maximum efficiency. The AVC line in association with any cathode resistors

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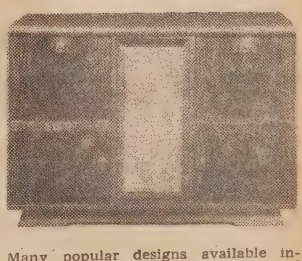

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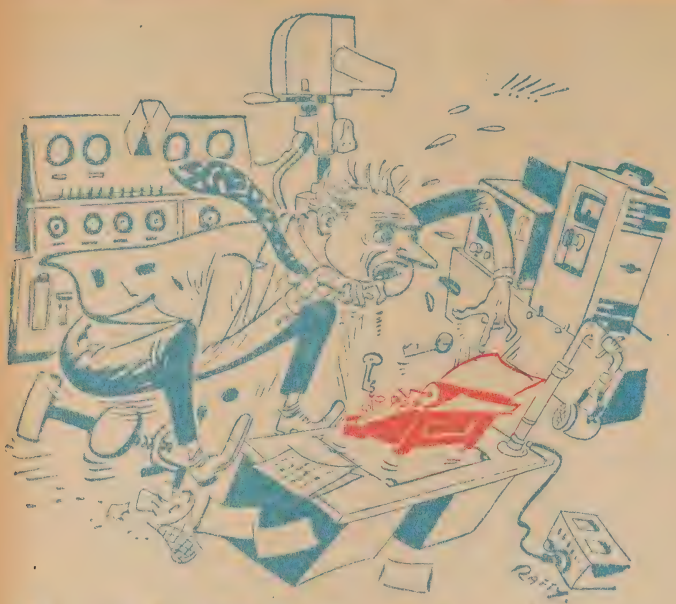

Let's Buy An Argument

For just about as long as I can remember, designers, constructors and servicemen alike have been plagued by the vagaries of the trimming devices used in connection with coils and IF transformers. Is it any wonder that most of us are plainly sceptical about new developments which will allegedly "solve the problem for all time."

by Neville Williams

IN case you think I'm exaggerating the position, just cast your mind back a few years and check your own experiences.

Up to the middle thirties, nearly all sets used mica compression trimmers of one type or another. They were built on to gang capacitors, mounted in pairs on IF mouldings, assembled on to bakelite strips or made up as single chassis-mounting units.

Varieties were legion.

TRIMMER LIMITATIONS

The best of them were effective enough — provided the associated circuit did not call for highly critical tuning and did not require the trimmer to be set toward either extreme of its range.

But looking back over those days, as one engaged in building and servicing receivers, I can recall a whole series of regular "misadventures" which were calculated to try the patience of even the proverbial Job.

Check the following list and see if it stirs any memories:-

(1) The outer leaf tended to lose its springiness, especially after being tightened right down. The trimmer forthwith had to be taken to pieces and the leaf bent up again, before the full range of adjustment could be obtained.

(2) During the above operation the bottom nut, used on some types, was often most difficult to replace in situ. Types without a bottom nut had their own troubles. The moulded thread used to strip at the most awkward times.

(3) Even if the spring leaf remained good, opening the trimmer often caused the adjusting screw to assume an oblique angle through the base moulding. It tended to bind and make the adjustment very jumpy. More fiddling and bending

(4) Tightening the trimmer to near full capacitance often caused the outer leaf to buckle so that the last clockwise turn of the screw would actually decrease the capacitance again, giving a false peak in the adjustment.

There were other troubles, of course such as cracked mica, un-tinnable lugs, chemical fouling and loss of electrical efficiency.

I remember one batch of IF trimmers which went on the market, having all the appearance of being well engineered. The leaves were well-shaped and stout, the adjusting screws well fitted and the base moulding above reproach.

A HIDDEN FAULT

The only trouble was that the tubular rivet holding down the spring leaf was not quite heavy enough. Under pressure, with the trimmer tightened well up, it gradually unrolled to release the "fixed" end of the leaf.

Every few weeks or months, sets using these trimmers mysteriously required realignment.

Being a "hidden" fault, nobody woke up to it for several weeks, by which time quite a lot of the trimmers and IF transformers had got into circulation.

Thereafter, as the sets came in for attention, the offending parts had to be dismantled and bolts passed through each of the rivets to prevent further trouble.

You can imagine how deliriously happy every one felt about it.

Then I remember the bother we often had when sealing down some of the trimmers — a trap which still claims its victims. If the sealing material was liquid enough to penetrate between the trimmer plates, it acted as additional dielectric and increased the capacitance.

The very act of securing the alignment upset it.

If you want to watch the effect, just set up a receiver with a low signal input and an output meter, peak up a sharp trimmer and then drip lacquer down into its "works". The output will often drop away in the most alarming fashion.

Knowing the limitation of mica trimmers, quite a few firms imported or produced miniature air-dielectric types, like tiny little tuning capacitors.

Remember them? The way they shorted? The way they collected dust? The limited range of adjustment? The

ilse peaks as the plates passed through
ieir full-in or full-out positions?

Nor can I forget some of the con-
entric types, with their tricks of short-
ig or opening, their tendency to bind
nd to progress from one setting to
ie other in a series of acrobatic little
imps.

No wonder we were all so interested
i the idea of variable iron cores, if
nly because they looked like solving
ie trimmer problem in IF transformers
t least.

What we didn't know was that cores
ad a whole lot of tricks of their own,
ned up for the rising generation.

Remember those early cores with the
exagonal heads—aligned, often, through
he sides of the can?

CORES THAT JAMMED

They worked like a charm until they
vere peaked and sealed. Then they
tuck fast.

Later on, if the set seemed in need
of alignment, there were three possible
courses of action open to the service-
man:

(1) Play safe and not try to align the
set.

(2) Try —— and succeed. (Much
rejoicing.)

(3) Try —— and have one or more
of the hexagonal heads crumble under
the pressure. You then had the further
choice of arranging an expensive re-
placement or simply putting the set
back in its cabinet and saying nothing
about it.

(What would you do, etc.?)

Then came the cores moulded on to
the ends of brass screws. What a multi-
tude of problems these have produced
over the past few years.

Probably the worst and most con-
sistent stems from the mating of the
brass screw to the female thread. This
latter may be cut directly into the
base moulding; it may be an actual
nut moulded in position or it may be
a specially turned brass gadget with
or without a useless "locking" clip.

A tight thread gives an air of stability
to the whole device but is prone to
jamming. In trying to free it, you
don't dare put too much pressure on
the screwdriver slot, otherwise it breaks.

Then you have to resort to pliers
and "butcher" the thing!

THOSE LOOSE THREADS

In an effort to avoid the jamming
hazard, manufacturers at various times
have settled for loose threads. These
don't jam but the cores won't stay put
either!

I've known mantel sets which
would de-align themselves progressively
as vibration from the speaker gradually
wound the cores downhill.

I've known portables which would
operate very well — provided you didn't
take them anywhere in a train or a car.

Of course, you can seal the cores—
but what with? How many times can
you remember seeing official instruc-
tions or an official sealing compound
put out by the manufacturers of iron-
cored components?

They go to all kinds of trouble in
other respects but tacitly assume that
the user can find his own solution for
the sealing problem. (The play on the
word solution is quite intentional.)

The one bright thought is that such
cores can often be held firm by the
use of lock-nuts, tightening against the
face of the moulding.

Such a simple idea and so cheap,

NEW USE FOR OLD PLASTIC HOSE

Dear Sir.

As a fairly constant reaaer of your magazine, I feel impelled to make comment, which I feel, would be suitable for your "Let's Buy an Argument" series.

Some of my background would probably clear up any oddity which you may infer into the matter to follow. I am a motor mechanic by trade but, during the war, I had the misfortune to be trained as a W.O.M. by the RAAF, a training which I used after the war to earn a living as a radio mechanic for a matter of 5 or 6 years.

Then and now I find the subject of electronics interesting but, since I no longer feed on my grasp of the subject, as it were, but have reverted to motor work, I find that I am able to hold strange and unorthodox views without much fear of repercussions, both sarcastic and pitying, from my fellow workers.

So much for that. The matter I had in mind was the matter of Hi-Fi. Hi-Fi has, over the past few years, become such a fetish among the fraternity of listeners both in and out of the radio trade that a worthy psychiatrist in the USA has at last classified the enthusiasm as a mental disease.

Now I think that such fusspotishness over a ½ db distortion at 15 Kc does, in fact, border on the brink of phobia. Surely one listens to music to be entertained by the magic of composers and the conductors with their orchestras, not to show Joe Blow how much better "my fidelity is than yours", to be crude and blunt.

It seems to me that enjoyment, not technicality, is the acme of any recording. For instance, I find an old 78 of Richard Crooks doing "The Holy City" far more enjoyable than a fairly modern 33 of "Carmen", with a stack of echo and a lousy musical talent.

With this theme in mind I conducted a little experiment on the more professional members of the radio fraternity. I obtained one of the latest and most universally regarded Hi-Fi reproducers from a good friend of mine.

Beside this I placed a reproducer built by myself, the fidelity curve of which could by no stretch of the imagination be called straight. The unorthodox feature of this latter amplifier was that of deliberate distortion. This was such that the curve dipped severely between 1000 and 200 cycles, so that the extreme trebles and basses were accentuated.

Further, this amplifier had a gimmick consisting of two awful dynamic microphones culled from army telephones feeding into 40 feet of plastic hosepipe. The idea of this was to get a "time" delay of approximately 0.004 sec.

As you no doubt know, these mikes are used both as transmitter and receiver. By having one at each end of the hose, one end to be fed from the reproducer and the other to be fed into its own amplifier, an effect approximating an artificial "live" hall was obtained.

In fairness to the professional gentry abovementioned, it must be admitted that they picked the Hi-Fi and the "brummy" sets from another room without any trouble. The significant feature of the experiment was the sequel when they brought around records — on another night — to be played "low-brow".

This proved to me that it is better to aim for psychological satisfaction than technical perfection.

Apparently the pseudo-stereoscopic effect tickled their fancy. While to any trained observer technical imperfections are self-evident, this deliberately imperfect reproducer gave a "roundness" and a "distance" effect which was very pleasing.

An improvement was to separate the trebles into the "delayed" channel and leave the bass to spout normally. This gave a definite depth to anything played and, even while running off a tone record which started at a high note and steadily varied to a low (like an extended "birdie") the note came closer as the middle register was approached.

I suppose this would be caused by phase differences, but I am not sufficiently knowledgeable to make any definite theory about the effect.

I therefore commend to your attention again that the enjoyment of equipment, not its proficiency according to the existing but changeable standards of the experts, is or should be the aim of builders. These two criteria are not necessarily related. In fact, a little deliberate distortion can work wonders.

I must point out here that non-technical people who had the chance to hear this equipment when it existed always chose it in preference to the better (?) standard equipment, army mikes or no army mikes.

Perhaps you would like to try this yourself. I can guarantee you a pleasant surprise! Anyway, this subject is always good for an argument, which is why I addressed it to your column in the first place.

Yours faithfully,

B. G. (Malabar, NSW)

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t I can't ever remember having seen packaged coil or IF transformer with k-nuts provided.

It might be suggested, of course, that ers, including homebuilders, provide eir own lock-nuts. True, but have u ever tried around the town to buy dozen 8BA nuts?

Actually, it's a bit late to start rrying about this now, because slugs brass screws are no longer the shion. Nowadays, the slugs are ulded with their own thread and ewed directly into the centre of the rmer.

GHT SLUGS

This is a very clever idea, because it ves the cost of the brass parts. It so saves the embarrassment which ises from having them too tight or o loose.

All that happens now is that the igs themselves get too tight or too ose.

This shouldn't happen, of course. he manufacturers will discuss at length e special features of their thread and rmer, the small tolerances and the rious etceteras which ensure smooth, sitive adjustment.

But such assurances are small comrt to anyone trying to force or drill chip a jammed core from a TV IF ansformer. I know. I've seen them it.

Nor did they mean much to me a w weeks ago, when taking home a ece of developmental gear for checkg. At the end of a 12-mile train urney, just about every slug had ound itself down the former enough throw the alignment completely out.

Again, the cores could or should have en sealed—but how? As far as the anufacturers are concerned, you can esumably try anything from roadside tumen to kitchen soap.

You can use coil dope or lacquer it whether you will ever be able to ift the core again is debatable.

EALING COMPOUND

You can use a hard wax or a seal- g compound with much the same jection.

You can use a soft wax but don't e surprised if it runs out when the uipment heats up.

You can probably use one of the rribly clever silicones, which never et hard and never get soft. But where an John Citizen buy three-pennyworth f the stuff? Certainly not from those ho should be most happy to see it circulation.

You know, I'm getting quite worked p about all this. If I show any more ndignation, I'll qualify for the remark hich I heard passed about a certain ell-known radio commentator:

"Slip him a couple of phenobarbs nd he'd have nothing left to say!"

But seriously, in the few months hich threaded cores have been in current use, I've heard many complaints bout problems like the following:—

(1) Cores so loose that they are hard to align, tending to move, even with normal handling on the test bench.

(2) No suitable sealing compound.

(3) Cores so tight that they can't be adjusted with non-metallic lining tools. Some jam completely.

(4) Moulded formers which tend to droop in hot situations or to yield under tension from the windings. The core may jam as a result.

These things shouldn't happen, I know—any more than the things listed earlier for troublesome trimmers.

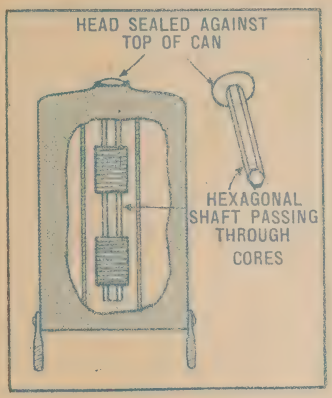
But they do.

And they drive you to distraction.

As if it isn't enough that half the transformers, coils and traps you strike these days have two distinct core positions where the windings will peak. I can't imagine that the intended coupling factors remain the same for both positions, but how does the constructor or serviceman know which from t'other?

I suppose it's the old story all over again. If we didn't haggle about the last penny, the manufacturer might be able to tighten his tolerances and put more into his design in the first place.

But it still drives you mad!



A possible solution to the problem of sealing miniature IF transformers. The rods would not need to be very strong. They could be cheaply made to a standard length and clipped shorter where necessary.

MY OWN IDEA

Can I make one small contribution in print, thereby preventing myself or anybody else from patenting the idea?

Why not have a little moulding rather like a nail, with a half-round head and a hexagonal shaft which fits the slot in currently used cores?

After the cores have been peaked, the said gadget would be passed down through the core or cores and the flat head sealed against the top of the can.

It would look pretty and "official" and do the job required. It could be removed readily and no one would care much if it were broken in the process. The things could be produced and sold so cheaply.

But gad, sir! The hexagonal holes may not always line up to allow the gadget to pass through both cores.

Touche! (Pardon my dodging back and forth across the Channel).

If the holes do not line up, the maximum error could only be one-twelth of a turn for one slug or one twenty-fourth of a turn, if one were prepared to "wiggle" both slugs to pass the locking rod through.

TWO RODS

Only in very critical circuits would this matter.

You could possibly use two separate locking rods, and even slot the heads so that, before sealing against the moulding, each would double as an aid to alignment.

You like the idea?

Okay.

You don't like the idea?

Still okay. After all, it didn't cost you much!

On the way through to this point in the article, you will have passed over a letter headed "New Use For Old Plastic Hose". This isn't a handyman hint put in to fill up an odd corner but is, in fact, a letter addressed to Yours Truly by way of these columns.

Had the letter merely re-stated the suggestion that amplifiers must satisfy the ear first and the eye last, it might easily have been passed over.

It's a fine old subject, of course, and one to be enjoyed about once a year —like Christmas pudding. But one couldn't possibly tolerate a continuous diet of Christmas pudding.

The letter is distinguished rather by the lengths to which B.G. has apparently gone in an attempt to demonstrate his point.

I've heard of reverberation devices of many kinds but never one made up from dynamic earphones and a length of garden hose. In fact, one member of the staff, who read the original letter, was inclined to treat it as a hoax, thereby reflecting gravely on the integrity of our worthy correspondent.

NEW USE FOR HOSE

One thing is certain, namely that the frequency response characteristic of the "echo" path must be appalling, with the cumulative characteristics of two dynamic headphones, let alone the length of plastic hose

But perhaps this isn't as tragic as it seems.

After all, what is the frequency characteristics of an actual echo path?

I'd be surprised if it were anything like as flat as the synthetic echoes obtained by delay systems using hi-fi tape systems.

But why argue? I guess plenty of readers can rustle up a couple of dynamic headphones, a spare amplifier and a garden hose.

Whether the result will be pleasant (as suggested) or surprising or startling or shocking or appalling or grotesque or nauseating — I leave you to find out.

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FROM THE SERVICEMAN WHO TELLS

It seems that even radio faults are being influenced by the jet age, or so it would appear from an experience I had this month. A fault which, in the normal way would have produced the steady "putt-putt" of a motor boat chose to create a high pitched scream. If this goes on I'll have to revise all my common symptoms.

BUT before I tell my stories here are some comments from a fellow serviceman on the other side of the world. Gibraltar, to be exact. He is Mr. D.G.S., formerly of Australia, then of Scotland, and now Gibraltar. (Certainly gets around, but what's the betting he'll be back in Australia before long?) Anyway, I quote the relevant portion of his letter below:

"Most service work here is battery/mains portables, the main complaint being low sensitivity. It always turns out to be the IF valve, a DF96, with low emission.

"I am longing to hear some nice quiet Australian commercial stations, as the local stations around here are either Spanish, Arabic, or French. The Spanish sound as if someone had stood on their toes; the Arabs as if someone were choking them; and the French sort of drool!

"I have often heard it said that the Aussies were lazy, but comparing one with a Spaniard, the Aussie appears jet propelled!

"Working hours are poor here. In my case, being a shop worker, I start at 9 am, finish at 1 pm, start again at 3 pm and toil on until 8 pm, Monday to Friday. Saturdays are from 10 am until 1 pm. What a life!

COMMON FALLACY

"I saw a real good one in an English radio mag. recently. It stated: 'The loudspeaker used in the author's recorder is a 3in, taken from a battery portable. However, it is not necessary to use a very small speaker as the output from the ATP4 is considerable, and will easily operate larger models.' Any comments?

"Having just received the October issue of R. T. and H. and browsed over the article on power supplies for portables, I have extracted from a service sheet the circuit used for a power supply in a German portable which we sell here. It uses .025 A valves.

"It gives quite good results, the hum being inaudible beyond about 3ft on a 5in speaker."

Well, thanks, D.G.S., and your comments are most interesting. Incidentally, I wonder if we always appreciate how fortunate we are in Australia in not having any language problem to complicate our radio set-up. Imagine "Mary Livingstone, M.D." in Arabic!

The two technical points mentioned are most interesting and worthy of comment. The first one, concerning speaker sizes, appears to be one of the regulars which, according to the staff members, turns up at least once a month in the R. T. and H. mailbag.

That, of course, is understandable, since there is always a batch of "new chums" coming along who are likely to be puzzled by such problems. But to encounter such a statement in a technical magazine—and —an English magazine at that—comes as something of a shaker.

Seriously though, this is clearly an idea that dies hard, probably because the so obvious assumption is the wrong one. Certainly a small speaker looks as though it would be easier to "drive", while the assumption is further encouraged by the manner in which various speakers are normally used.

A QUESTION OF POWER

For example, a high fidelity fan with a 12 or 15in speaker invariably uses an amplifier somewhere between 20 and 40 watts, while a portable with a 3in speaker is lucky if it can muster 300 milliwatts. Looking at it that way, it is not surprising that the impression is one of larger speakers needing more power.

In fact, the opposite is the case. The 3in speaker is a notoriously inefficient device—by speaker standards—and is only tolerated because size is so often an important factor. The fact that the amount of power available is severely limited only makes matters worse and is the reason why most portables sound so atrocious in the hands of the average user. They never do seem able to grasp the fact that the set just isn't capable of delivering the power they are demanding of it.

If we did the logical thing—from an electrical point of view—we would make the best use of this limited power by feeding to the largest and most efficient speaker we could find, probably a 12 or 15in type with an enormous magnet. This would make the set so big and heavy that it would be impossible to carry it to the beach on a Sunday morning and annoy everyone within range.

And a good thing, too!

Since the use of a highly efficient speaker is obviously impossible we have to be content with something less; just how much less depending on the amount of volume we require and the amount of distortion we are prepared to accept. Thus the choice of the 3in speaker is more or less forced upon us—in spite of its limitations—if we require extreme portability.

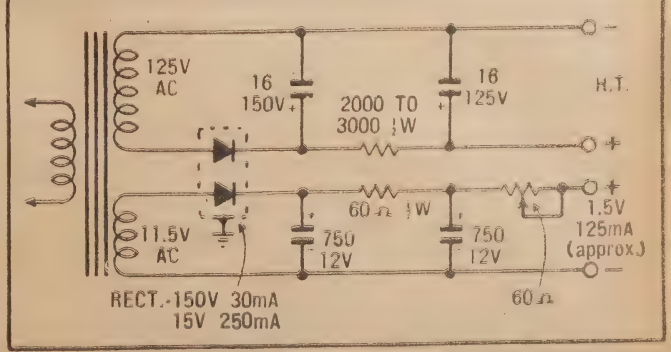
On the other hand, we normally find the largest speakers associated with high-power amplifiers, not because they need a lot of power to drive them, but because the user wants to make a lot of noise (that's why he built a big amplifier) and needs a large speaker to handle the power.

EFFICIENCY AND SIZE

And to make sure there is no confusion on this last point let us clarify it a little further. A large speaker can "handle" a lot of power while a small speaker can "handle" very little, but this is something quite different from the amount of power needed to "drive" either one to give an equal amount of acoustic output. The larger speaker will normally wins hands down on this last point.

I will conclude this little discussion by expressing the hope that I have now done my bit in "scotching" false ideas about speaker sensitivities. After all, I suppose if enough people say the same thing sufficiently often it must sink in eventually.

The other matter raised by my cor-



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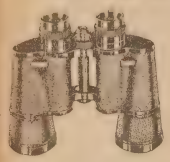

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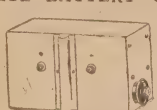

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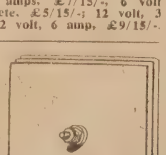

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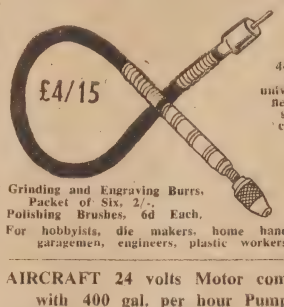

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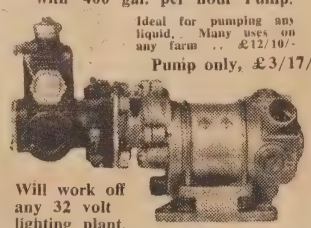

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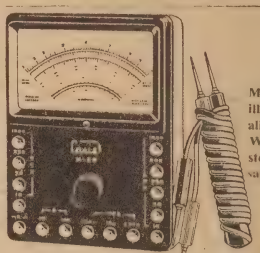

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spondent—the portable power supply is also very interesting. Anyone who s read articles on this subject in past ues of R. and H. and R. T. and H. ll have gained the impression that it virtually impossible to provide an equately filtered 1.5-volt power supply thout recourse to a dry cell (or simi- device) as a final filter unit.

In the light of this, must we now sume that the German designers have lled a trick which was overlooked by ustralian engineers? Frankly, I don't link so. I think careful analysis of e position will show that the two uations are quite different.

First, there is the question of what nstitutes hum-free performance. binions will vary considerably on this, pending on whether you are an ultra ssy engineer or, at the other extreme, scatter-brained teenager who would rrive as much pleasure from 50 cps as y other noise.

OW MUCH HUM?

D.G.S. says,-". . . the hum being in- dible beyond about three feet, &c.," d we could doubtless argue indefinitely hether this is excessive or not. Per- nally, I would consider it very much border-line case, particularly as the vailable power output would be appre- ably less from the 25 mA series out- ut valve than from, say, a 3V4 or 3S4.

In other words, I imagine one would ot feel inclined to use the set at a istance much beyond three feet, un- ss listening conditions were very quiet. n the other hand, such sets are fre- uently used at much lesser distances s bedside sets, &c.), and I imagine he hum would be intolerable under uch conditions.

The use of the 25 mA series valves also important in another respect. With, approximately, only half the cur- ent drain to worry about, the job of ltering would certainly be much easier. n addition, since the supply was de- igned for use with a particular set as distinct from a universal supply) t is likely that the response of the set would be deliberately restricted around 0 cycles.

ROBLEM NOT EASY

Yet we find that, even with so many actors in their favor, the German de- igners could still only produce what ap- ears to be barely acceptable perform- nce. Don't misunderstand me; I'm not lecrying their efforts; but I do think that he facts only serve to emphasise how difficult the job is.

It is perhaps significent that one Euro- ean firm has recently produced a sealed, ong life, miniature accumulator for the express purpose of providing a highly efficient and reliable final filter for just uch power supplies. Doubtless, if they are a success we will see them in this country before very long.

No, I don't think the problem is any easier in Europe than in Australia. After all, 50 cps power behaves much the same in both places.

Coming down to more mundane mat- ters I had a somewhat puzzling encounter with an amplifier a few days ago. It was an R T and H Playmaster No. 12 to be exact, and the owner complained of excessive background noise. Further, according to him, this only developed after the set had been running for about 15 minutes and was sufficiently severe to completely wreck the performance.

I set it up on the bench, switched it on, and noted the time—just in case the 15 minute period had any significance. The set was perfectly quiet when it warmed up and a preliminary check over failed to reveal anything obvious. I decided to leave it and wait for something to happen.

Sure enough, almost exactly 15 minutes later the speaker commenced to give forth crackling and spluttering noises at a high level. I turned the chassis over, grabbed a screwdriver, and commenced shorting out various stages. It didn't take me long to confine the trouble to the first stage, the EF86 triode connected driver.

A little gentle tapping around the associated components seemed to suggest that the plate load could be the culprit. It required only a few minutes to change it, and the diagnosis seemed to be confirmed when I switched on again and noted that all was quiet.

I was just congratulating myself on a snappy diagnosis and a quick repair when I realised that the amplifier was still not perfectly quiet. Admittedly, the noise was nothing like the previous level, which was probably why I hadn't noticed it right off, but I can well imagine a fussy enthusiast being worried by it.

STILL THE EF86

Once again it seemed to be associated with the EF86 stage, even to the point where moving the EF86 caused the noise to vary. Preparing to congratulate myself again I reached for a spare EF86, plugged it in, and waited for it to warm up. I was somewhat shaken when it did, for the noise was still there, just as healthy as ever.

I decided it was time to stop fiddling and really come to grips with it. I checked the socket connections for dry joints, I inserted a sharp pointed instrument alongside each contact and effectively tightened it, and I cleaned the socket with a commercial version of the old carbon-tetrachloride standby.

It was all wasted effort. The stage was still noisy and the noise was definitely associated with the movement of the valve in the socket. Since I felt virtually certain that the valve was not at fault it could only be the socket; yet there seemed no reason for it.

Then I recalled an incident related to me by a colleague several months previously. The exact details had long since escaped me, but I remembered that the vital point was an inexplicable noise which was only cured by replacing the valve socket. Since there seemed to be nothing to lose and the socket was readily accessible I decided to give it a go.

SOCKET CURE

Ten minutes later with a new (identical) socket fitted and wired I switched on and waited. The unit warmed up without a sound, and continued to behave itself in spite of repeated bumping and bashing. After a prolonged run on the bench and some further bumping without any trouble I considered the point proved. As far as I was concerned the socket was the culprit.

As to the exact cause; well, your guess is as good as mine. Perhaps it was a contact which failed in spite of my efforts; perhaps it was a stray leakage path between pins due to faulty moulding material. But, whatever it was, it was most easily cured by changing the socket. In the circumstances it seemed the most logical attack, even if the exact cause remains a mystery.

THE SQUEALING MANTEL

Another set I encountered this month exhibited rather unusual symptoms. It was a well-known four-valve mantel set and the owner's complaint was that it "squealed". This is normally such a common fault that I paid little attention to it, beyond registering mentally

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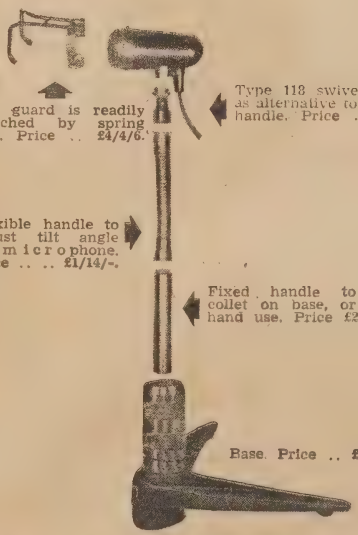
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58 HIGH ST., GLEN IRIS, SE6, VIC.

th it was probably an open circuit
s en by-pass causing the set to "take
ol".

On switching on the set squealed all
rit; but not in the manner I had
ected. In place of the usual hetero-
de whistle accompanying each station
I as greeted by a solid howl of about
20 cycles. It sounded for all the
wld like a peaky PA system which
h taken off. Also, it was quite dis-
tingly loud.

TONE CONTROL CLUE

Furthermore, I quickly established
t it was completely divorced from
t front end of the set. Adjustment
o the tuned circuits had no effect, nor
d the position of the volume control.
T only thing which did affect it was
t tone control. This was a simple
to-position device which in one posi-
tn did nothing and in the other pro-
ced a pretty severe top cut.

Bringing in the top cut would either
s p the oscillation completely or re-
d e it to a few hundred cycles, de-
p ding on the whim of the device.
S ce the tone control switch was a
v y poor thing mechanically and re-
f ed to stay in the top cut position
u ess held there, the set simply howled
ji head off.

Without thinking too much about
c se and effect I reached for a .5 mfd
ad placed it between the HT line and
c ssis. The reason I did so is simply
t t this treatment is effective in a
s prising number of instability cases,
m inly due to the absence or failure
c the HT paper by-pass.

The .5 mfd stopped the howl and
t set showed some signs of life. It
w sn't very healthy as yet, however,
t audio being thin and reedy with a
c tinct "ringing" characteristic. This
l ter suggested that the whole thing
w s still on the verge of oscillation.

Having established this much I de-
c ded it was time to take more careful
s ck of the situation and determine
t exa t cause of the trouble. The
c cuit was a reflex arrangement—a
p int of some importance as it ulti-
m ately transpired—and the first thing
l looked for was a HT paper by-pass.
T e need for this by-pass is usually
s en greater in a reflex set than in the
m re conventional circuit.

It was there all right, and intact as
w ll, as I established by checking it
o the bridge. It followed almost auto-
m atically, therefore, there was still not
e ough capacitance in this part of the
c cuit.

DEATH OF ELECTROLYTIC

With the .5 mfd still in place I
p aced my fingertips gently on the cone
o the speaker. There was quite a
s bstantial hum level present, even
t ough it was virtually inaudible, due
t the small speaker and lack of
b inet.

With one hand still checking the
h m, I used the other to wangle an
e ectrolytic across the HT line. The hum
v nished immediately and the set became
q ite docile. The audio quality be-
c me full blooded once more, the ring-
i g quality vanished, and I was able
t remove the temporary .5 mfd.
C learly, the second electrolyic had
h ad it".

In the circumstances it wasn't sur-
p rising that oscillation of some kind
t ok place. Lack of capacitance across
any power supply will, by reason of
the high impedance it creates, provide
unwanted coupling between stages. In
the front end of a set it produces
oscillation which shows up as hetero-
dynes, etc., while in the audio section
it generally produces motor-boating.

In this case the frequency was a
good deal higher than the very low
frequency effect we know as motor-
boating, plus the fact that the exact
audio feedback path wasn't immediately
obvious. In the hope that solving the
second effect might also solve the first,
I took pencil and paper and proceeded
to trace the relevant portion of the
circuit.

At first I assumed that the audio sec-
tion of the reflex stage was forming
part of the feedback loop but on more
careful consideration I discarded the
theory. For one thing it was difficult
to establish a connection, at audio fre-
quencies, between the grid and the HT
line. More important was the fact that
the volume control—which was in this
grid circuit—had no effect on the oscil-
lation.

PROVING THE POINT

To prove the point I restored the con-
ditions to cause oscillation and removed
the reflex stage. The oscillations con-
tinued merrily without change in fre-
quency or amplitude. Quite obviously
the oscillation involved the output stage
only. Somehow signals appearing in the
6V6 plate were being fed back into its
grid.

Looking at the circuit as far as I had
traced it showed how this could happen.
The grid of the 6V6 was coupled,
through a coupling condenser, to the
load resistor which formed part of the
total plate load for the reflex stage. The
remainder of the load, of course, was
the 2nd IF primary.

Since this plate circuit was connected
directly to the HT line, any voltage
changes at this point, due to current
changes in the 6V6 plate circuit, would
eventually appear on the 6V6 grid. In
short, it was a perfect feedback circuit.

As for the frequency of oscillation;
well, I'm afraid that is one of those
problems for which there was no obvious
answer. There were probably several
factors governing the frequency, though
the one likely to have the most say
would be the speaker transformer. If
it had any kind of a peak around 2000
cycles it could easily be the deciding
factor.

Summing up, one may say that this
was simply another case of motor-boat-
ing—except that the motor-boat was
one of the jet propelled variety rather
than the more common "putt-putt boat".
In more technical terms, the only thing
which had changed was the frequency,
though this change did make the pos-
sible cause less obvious.

The other interesting point is that
such feedback can occur in a four-valve
reflex set, whereas it would be extremely
unlikely in a simple four-valve set, due
to the absence of any coupling (at audio
frequencies) between the output valve
grid and the HT line.

MAGIC STOVE

And now, to round things off for this
month, I simply cannot ignore a local
newspaper report concerning a so-called
"magic" stove which plays two of the
local broadcast stations as well as cook-
ing the dinner.

For a choice piece of journalistic
ballyhoo I consider it about the best
I have ever encountered. It reads, in
part, as follows:

"Out at Carlingford there's a magic
electric stove which is a different kettle
of fish from anything you have ever
seen—or heard.

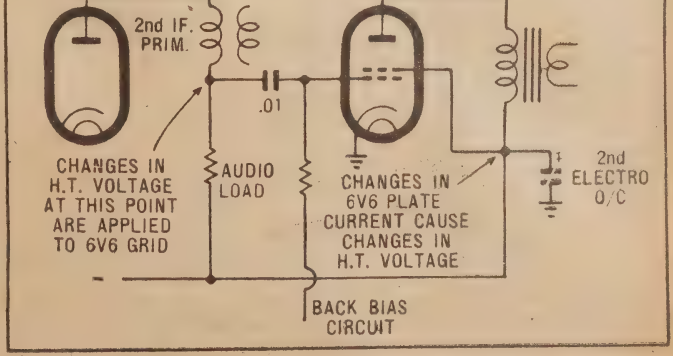
"On the hotplate of this stove the air-
waves combine with the heat-waves to
give a real element of surprise. You
can listen in to station 2SM and some-
times 2CH.

"The family can have serials with
their cereals, hot 'licks' with their wheat
biscuits, news with their stews, or tunes
with their prunes."

The remainder of the report was in
a similar flippant vein, making it rather
difficult to make much real sense from
it. However, as far as I could determine
the facts were as follows:

(1) The stove was about 10 years old
but had only started to "play" after
some recent changes in the electrical
wiring.

(2) It sometimes played quite loudly
without the addition of any attachments,


REFLEX STAGE
6V6
2nd IF. PRIM.
.01
CHANGES IN H.T. VOLTAGE AT THIS POINT ARE APPLIED TO 6V6 GRID
AUDIO LOAD
CHANGES IN 6V6 PLATE CURRENT CAUSE CHANGES IN H.T. VOLTAGE
2nd ELECTRO 0/C
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hile, at other times, it was necessary connect a pair of headphones to it. he exact method of connection was ot stated.

(3) It only played when the stove was vitched on, and

(4) the locality was quite near the ommon aerial shared by the two ations concerned.

RYPTIC EXPLANATION

In the entire article, nearly a column length, there was only one pararaph, the last one, devoted to any ttempt to explain the phenomena. This ated:

"A senior lecturer in communication ngineering at Sydney University said oday the phenomena could be caused y a faulty contact between two pieces f metal in the stove."

Which explanation appears to be a erfectly logical one as far as it goes ut is quite obviously only part of the tory.

Let me state right here and now that his is by no means the first report of n incident of this kind. I seemed to emember something like this being reorted in the old Wireless Weekly days, nd said as much to the Editor. With vhat I can only describe as photoraphic memory he immediately sugested "July, 1932". We checked hrough the files and quickly tracked t down. It was September, 1932, as t happened, but I still think it was pretty god effort after 25 years!

To be more exact, and for the benefit of any readers whose files go back hat far, it is on page 12, of the September 9 issue, 1932. I think part of t is worth quoting:

ECHO FROM HISTORY

"A friend of mine, who is also a contributor to 'Wireless Weekly', and a well-known experimenter in Sydney wireless circles, has been troubled by gas stoves. Not the ordinary kind, but talking gas stoves.

"Most of us have heard at one time or another of the famous spade that hangs up somewhere and emits programs from the local station. Every now and then we hear reports of similar inexplicable and accidental loudspeakers suddenly announcing market reports, but we know these radio fiends and there are two born every minute.

"However, this friend of mind, by some strange coincidence, was spending an odd quarter of an hour with his head in a gas stove. Imagine his surprise when, while installed in this soul-satisfying pose, he was brought to earth by strains of music. There was no doubt about it, he assured me, the program was from 2KY and the call sign was distinctly heard."

My immediate comment was that the gas stoves of 25 years ago obviously had a much poorer musical taste than the electric stoves of today! Perhaps in another 25 years they may get around to the ABC.

Seriously though, assuming these reports are reliable—and I believe they are—what is the explanation? I suggest it is as follows:

In all such cases the "receiver" has been quite close to the transmitter concerned, generally in what is called the "shock area". Also there has been some form of clearly recognisable rectifier,

(Continued on next page)

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Sec.: 3.7 or 15 ohms
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The authors' approach is to consider he many controls and adjustments to be ound on television receivers, to explain heir function and then show the results of right and wrong setting.

Inevitably some of the text, particularly where dealing with interference and erials, is more appropriate to British han Australian standards, but allowance an readily be made for this. The book is well worth the 8/6 quoted as the local price. Postage is 9d extra. (Our copy from the Technical Book and Magazine Co., 295-299 Swanston St., Melbourne.)

INTRODUCTION TO COLOR TV, by M. Kaufman and H. Thomas. Published by John F. Rider; stiff paper cover, 156 pages.

The first edition of this book, published in 1954, may already be familiar to some readers. This second edition, dated 1956, has been brought up to date and into line with the many rapid developments in this field. Though color television may have no immediate local application it is a subject on which most television enthusiasts like to be reasonably informed.

This book is written in a descriptive rather than a mathematical style and is profusely illustrated with sketches and circuits. It is not easy reading—because the subject itself is involved—but anyone with a reasonable grasp of radio and television generally will be able to follow it readily enough.

After answering a few questions from the user's viewpoint the book opens with a chapter on the fundamentals of color presentation, particularly in relation to television. This leads into a discussion of the NTSC system, as used in the US.

Tricolor picture tubes are treated next and then, mostly in block schematic form, the operation of a color TV receiver.

The adjustment of color TV receivers is also covered and a couple of complete schematic circuits are included for good measure. (Our copy direct from the publishers. American price two dollars 70 cents.)

FROM THE SERVICEMAN WHO TELLS

(Continued from Page 53)

such as a junction of two pieces of rusty or corroded metal.

The effectiveness of such crude rectifiers has been demonstrated on many occasions, particularly during the last war when Allied POW's made quite efficient detectors from such homely materials as a safety-pin and a rusty razor blade. The commercial copper oxide rectifier is, after all, only a refined version of such devices.

Taking into account the proximity of the station, plus the presence of power mains which could act as an aerial, it is only reasonable to expect that quite a lot of RF power could be present across such a crude rectifier, certainly enough to operate a pair of headphones if they were connected across it.

(At the same time, such a procedure would appear to be a very unwise one in this case. There is no guarantee that the stove is not defective in some way and I, for one, would not be very keen about probing into the innards of a stove with a pair of headphones particularly while it was switched on.)

The real mystery appears to be the manner in which the resultant rectified current, representing audio signals, can be rendered audible without the presence of headphones or a loudspeaker. As far as I can determine there is simply a loose piece of metal associated with the rectifier and I can only suggest that this is affected by either the electrostatic or electromagnetic field —whichever is the more prominent—and becomes a crude loudspeaker.

In other words, the whole thing appears to be the result of perfectly natural laws—plus a lot of sheer brute force. It is not even essential to make connection to the mains, as demonstrated by the gas stove episode, though such a condition would obviously help.

These suggestions are, of course, partly conjecture, but I offer them as a reasonable explanation of an otherwise puzzling experience. If anyone else can support a more logical theory I would be glad to hear it.

But please, Mr. Reporter, whatever it is, it isn't magic!

HERE'S YOUR ANSWER, TOM

(Continued from page 41)

which might be included, should provide the optimum negative bias on the controlled valves with no signal. With a back-bias system, earthing the AVC line would cause the valves to draw more than the normal current but in most cases the sensitivity would actually decrease under these conditions.

If the receiver has been designed to deliberately operate with extra bias, either to ensure sensitivity or to reduce high tension current, reducing the bias would give more gain. But removing it altogether is not likely to improve it in any way.

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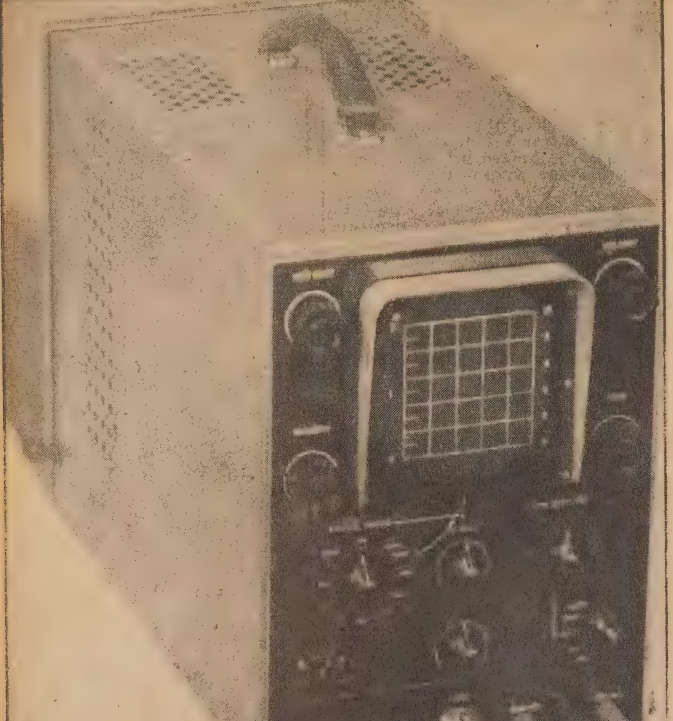


Finished instrument has a professional appearance. At 17½ x 12½ x 9 inches, overall dimensions are smaller than for previous 5BP1 oscilloscopes.

NEW WIDE BAND OSCILLOSCOPE

In this article we continue with the general description of our new, wide-band oscilloscope which was commenced last month. It uses components which are readily obtainable to professional servicemen and home constructors.

PART 2

by Maurice Findlay

PART 1 of the article appeared in the February issue. The mechanical features, the design of the wide-band vertical amplifier and the problems of preventing spurious deflection of the electron beam by stray magnetic fields were discussed in general terms.

In addition, the electrical circuits of the instrument appeared in the February issue.

We continue now with the subject of stray magnetic fields and means of preventing them distorting the spot. This is a problem with all oscilloscopes and obviously becomes more acute as the power is increased to meet the demands of wideband amplifiers.

The easy way out is to build the power supply in a separate case which can be placed remote from the amplifier and indicator circuits but in a busy service workshop there is no doubt of the convenience of an instrument complete in the one case.

From the power supply circuit (page 75, February issue) you will note that two power transformers are used, one supplying the main high tension and the other the filaments plus the extended high tension.

The two transformers are mounted sid by side on the chassis and the primarie phased so the external fields tend t cancel. It is a simple matter to revers the primary leads of the transforme when the instrument is complete t determine the best connection. Leav the magnetic shield off the cathode ra tube for initial tests for the most definit indication.

Reversing the primaries will revers the relative phase of the high tensio and extended high tension windings. the connection between the two is mad at the 5V4-G socket it is a simple ma ter to transfer the lead between pins and 6 as required to make the 860-vo winding add to 340 winding.

FIELD CANCELLATION

In practice complete cancellation the fields will not occur for several re sons. The two transformers must hav some physical separation and therefo there must always be a point in spac where there is a residual field even whe all other things are equal.

Complete balance of the transforme is not practical since it would involv placing part of one winding on eac core and would lead to a prohibitiv number of connecting leads as well duplication of high voltage insulatio Both factors would add appreciably the cost and bulk.

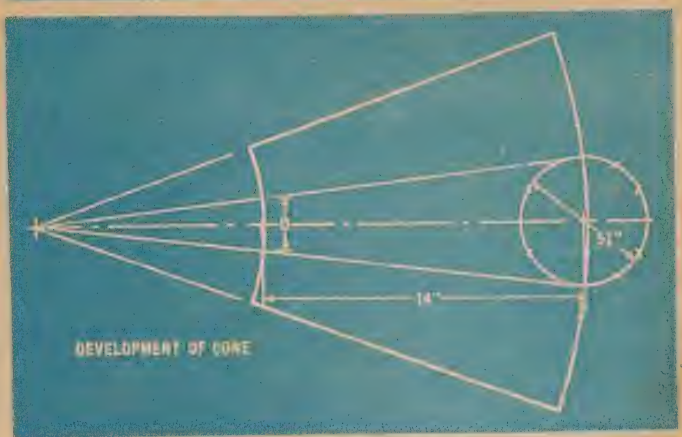
The best compromise between th conflicting factors appears when th centre tapped high tension winding placed on one core and the filament and extended high tension on the othe

The power handled by the two trans formers is not exactly balanced. Apa from this, the flux waveform of t transformer feeding the 5V4-G rectifi is different from the flux waveform the filament transformer, and therefo complete cancellation could not tak place in any case.

Despite the foregoing, the ratio the elongation of the spot with the fiel adding and subtracting is about 3 to and therefore the improvement is wo worth while.

Before this, care had been taken design each transformer with as low external field as possible by increasi the iron content and placing a lo resistance copper band around t transformer. Previous experience wou suggest that an improvement by a fa tor of 2 or 3 to 1 at least results fro these precautions, but we have not h

MAGNETIC SHIELD FOR 5BP1 CRT



Development of mild steel cone. Begin by making an elevation drawing of completed cone. Continue sides until they meet. With this point as centre draw arcs to pass through the corner points of elevation. Step off circumference around larger arc.

opportunity to make a direct com- with transformers of normal density and without the copper

ven so, the field had not been re- d to the point where spurious ction could be considered small igh with the cathode ray tube pro- ed only by one of the short shields t as were used in the radar indica- units during the war.

hields for cathode ray tubes are quently made from high permeability ys which go under various trade es. Mumetal and Permalloy are well wn. Nickel and iron are their n constituents but minor elements heat treatment figure largely in final result.

ECTRICAL PROPERTIES

The electrical properties of these high meability alloys are affected by chanical strain and it is desirable t a final annealing take place after mechanical work has been carried t. The material should not then be opped or subject to any strain. For timum results the final annealing ould take place in a hydrogen atmos- ere. Facilities for doing the work nveniently are available to few.

Properly treated these nickel-iron loys are capable of realising an initial rmeability of 30,000 or more com- ared with a few hundred for iron, licon steel and other more readily vailable materials. The result is a ght and very effective shield.

A shield complete and annealed can e ordered but the delivery delay will e some months and the cost in the icinity of £5 or £6. If carefully reated the results will be excellent ut should the shield be dropped or ubjected to strong magnetic fields the ermeability may not be very much reater than for very ordinary materials.

With this background we set about designing a shield to be made from readily available materials which would reduce the spurious deflection to a satisfactory level.

An early suggestion was that one of the silicon steels as used for trans- former laminations would be suitable for a shield. At the inductions used for power transformers these alloys have permeabilities of the order of thousands.

SIMILAR TO STEEL

However, on further investigation it appears that the initial permeability is of the same order as that of mild steel, wrought iron and so on. Since we are dealing with very low flux levels it would appear that a "brute force" technique using ordinary materials is worth considering. They are, incidentally, much easier to work than silicon steel, which is hard and brittle.

A cathode ray tube is most sensitive to magnetic fields in the vicinity of the electron gun, since the electrons are moving relatively slowly at this end of the tube. Therefore the shielding must be more effective around the neck of the tube than around the cone where the electrons have the high velocity acquired by accelerating through almost 2 KV.

Iron water pipe, 2in inside diameter, is readily available and cheap. What it lacks in electrical properties it makes up in thickness.

Obviously the weight of a 5in length of 2in water pipe is too great to be supported by the tube and therefore the design must be such that the shield supports the tube.

Our solution is to construct a cone from mild steel of a size such that the tube can be placed inside the cone with good mechanical cushioning. It is not an easy matter to bend heavy gauge sheet metal into the shape of a cone and we feel that the heaviest mild steel sheet that readers will conveniently be able to handle is 16 gauge.

MAKING THE CONE

The development drawing for the cone is given here and you should not have too much difficulty in marking out the full-size development on sheet metal. Alternatively, a full-size blueprint of the cone development is available along with usual chassis blueprints.

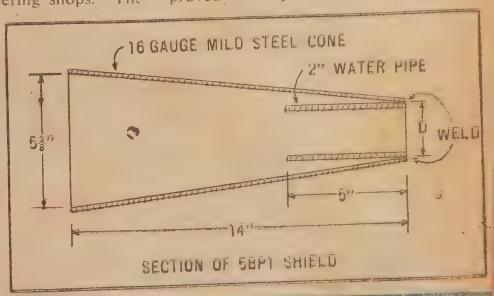
No allowance is made for a joint. This is best made by welding, which will provide the best magnetic circuit, that is, a joint with the least reluctance.

Mild steel is easy to weld with an oxy-acetylene flame and suitable facilities are available at many motor garages these days as well as engineering shops. The welding technique also offers the most satisfactory method of holding the length of water pipe in place and the two jobs can be done at the same time. Make the cone a fairly tight fit around the pipe and leave the last inch or so unwelded initially. The pipe can then be accurately centred and will hold its place while the weld is spotted in a couple of places.

While a butt joint of the cone with a cover strip spot welded or bolted over the join would make a neat mechanical job, a single lap joint would be preferred from a magnetic point of view. Either of these would only be used where an oxy-acetylene weld is not possible.

In order to ensure that the instrument will withstand normal handling and transport without damage to the cathode ray tube, the inside of the metal cone at the large diameter end should be lined with thin sponge rubber or felt. Similarly the inside of the water pipe should be lined to prevent contact between metal and the neck of the CR tube. A ring of felt or rubber around the 5in diam. hole in the front panel, inside, will prevent direct contact with the face of the CR tube. No other support for the tube will be necessary.

A shield to the above specifications proved entirely satisfactory in the new



Section of the assembled shield. A length of 2 inch water pipe provides the extra shielding required near the electron gun of the cathode ray tube.

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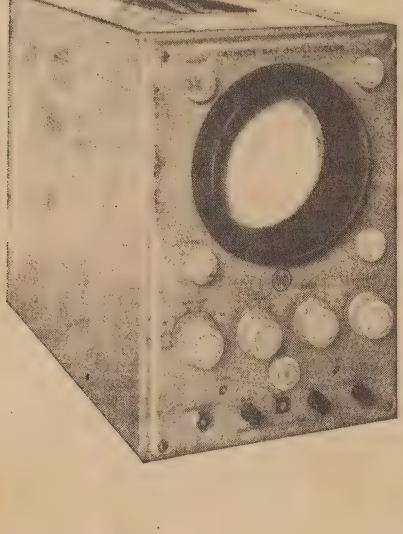

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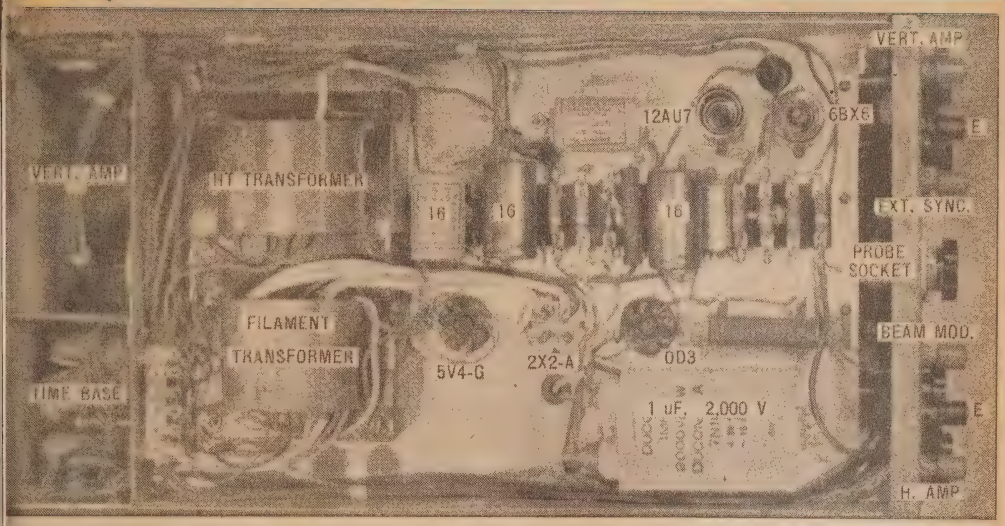
NDERNEATH PICTURE OF WIDE BAND INSTRUMENT



Most of the small components under the horizontal chassis are attached to a mounting strip. Since signal circuits are not involved wiring is not critical and may be bunched into cables wherever possible.

illoscope, and, with the CR tube alled in its normal position, no dis- ion of the spot due to magnetic ds could be detected. Even if you d power transformers and a filter ke with higher external fields than the original we do not think you uld be bothered by spurious deflec- .

TIGMATISM

Astigmatism is likely to occur if the eld has a permanent magnetic field. We do not think it is likely to reach ous proportions if ordinary mild el is used for the cone.

For the record, it is worth noting t there are other means which can used to reduce the stray field in vicinity of the CR tube. We found t a 4in mild steel plate 8½in by 5in ut halfway between the power trans- mers and the cathode ray tube re- ed the stray field by about 2 to 1. alternative position would need to found for the filter choke if it were ided to use the plate.

A small iron-cored inductor, say a aker transformer, connected to a ment winding, and with means of ying the current flowing in the ding, may prove a worthwhile ans of reducing the spurious deflec- when an effective shield is not ilable. It would be a matter of ding the position of the inductor the current flowing in it for best ts. Complete cancellation cannot pected because of the difference as waveforms.

BASE

Continuing the discussion of the erms of the new oscilloscope in al terms we now deal with hori- al deflection circuit. The schematic he time base oscillator/horizontal ifier complete appeared on page 73 of the February, 1957, issue.

We must confess that the circuit taken in bulk is not easy to digest.

It consists of a pentode valve operating as a Miller/transitron oscillator and generating a linear forward sweep for repetition frequencies between 10 c/s and 100 Kc/s for the component values given. The circuit will operate well at both higher and lower frequencies but for television testing and general laboratory work time base frequencies outside this range are not likely to be required.

FREQUENCY RANGE

Frequency coverage is divided into four ranges in the ratio of 10 to 1 making it a simple matter to calibrate the controls in terms of frequency. With the synchronising control turned almost off, a reasonably accurate indication of frequency can be obtained from the instrument.

A fifth position of the frequency range switch allows the valve to operate as an amplifier.

Negative feedback is necessary in order that the valve can deliver sufficient output with low distortion. The final amplifier which results from the switching circuit is able to give an undistorted deflection of 4in peak to peak and requires about 13 volts peak to peak (4.5V RMS approx.) input for full output.

For both amplifier and oscillator positions, output from the plate of the pentode is fed to the grid of a cathode follower (direct coupled) triode. The cathode of this valve is a low impedance source and is therefore a good point from which to charge the frequency determining capacitor. If the capacitor is charged directly from the plate of the valve as in the simple circuit used for the general description which follows, the flyback time will be much longer.

The cathode of the cathode follower also provides a low impedance source of signal for application to one of the horizontal deflector plates. The second deflector plate is supplied from the plate of a second triode. This valve has unity gain and is included merely to provide a signal in reverse phase. A high feedback factor ensures a low output impedance and low distortion.

Although it is not necessary to understand fully the theory behind the Miller/transitron oscillator in order to make the complete oscilloscope perform successfully, a brief description of its operation will be of interest.

A pentode valve connected in the basic circuit (see page 61) will generate continuous sawtooth waves. We will describe first the operation of the Miller integrator which generates the linear forward sweep.

Consider the condition at an instant during the cycle when the plate current of the valve is cut off. There is then no current flowing through R1, the voltage drop across R1 is equal to zero and one plate of capacitor C is at the potential of the high tension line.

INTEGRATOR OPERATION

The other plate of capacitor C is virtually at ground potential due to the diode action of the grid and cathode of the valve. The equivalent diode has a low forward resistance compared with R.

Under these conditions, assume that plate current begins to flow. This causes a voltage drop across R1 and makes the plate negative with respect to the high tension line. The grid is connected to the plate through capacitor C and therefore the grid is instantaneously driven negative by the same amount as the plate.

The initial sudden downward drop is

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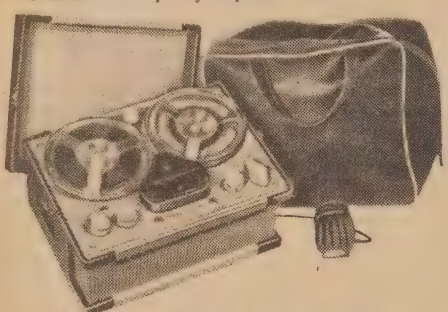

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only a few volts because the negative grid tends to reduce the plate current. The nett result is that the one effect checks the other and, provided the gain of the valve is high, the plate potential falls relatively slowly.

Again, provided the gain of the valve is high the slope of the plate voltage run down is linear and equal to —Eb/RC volts per second. The time taken for the run down can be calculated if the potential difference between the top and bottom of the run down is known. This is frequently almost equal to the supply voltage. One of the advantages of the circuit over gas triodes, multivibrators, etc., is that it is able to deliver a high output voltage.

The transitron action now begins. When the plate voltage has fallen to the point where the valve is operating on the bend of the pentode characteristic (plate voltage lower than screen voltage), the screen current increases. There is a sudden drop in screen voltage across the screen series dropping resistor, Rs, which has a value comparable with R1.

SUPPRESSOR VOLTAGE

Since the suppressor is connected to the screen via Cc, the suppressor voltage also falls quickly by the same amount (in fact, goes negative), with the result that the plate current is reduced.

The action is cumulative. The increase in screen current causes a reduction in plate current until finally the plate current is cut off. The change from normal screen voltage to a low screen voltage occurs quickly since the stray capacitances are relatively small.

Capacitor C now charges through R1. The circuit is completed by the equivalent diode formed by the grid and cathode of the valve. In the case of the simple circuit shown, this action takes an appreciable time, but in the practical circuit included in the instrument, the capacitor is charged by a cathode follower which has a very much lower internal resistance than R1. The flyback time is thus reduced to a relatively small figure.

At the same time capacitor Cc discharges through Rs, allowing the suppressor to become less negative, and by the time the potential at the plate has risen to the potential of the high tension line the suppressor is at about earth potential.

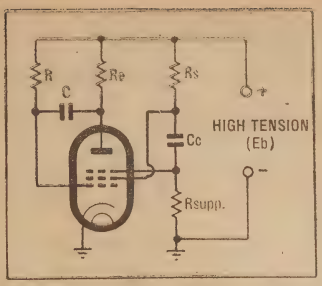
The entire cycle then begins again.

The time constant of CcR supp must be suitably related to the time constant CR if the maximum amplitude and at the same time minimum flyback time is required. If, for example, with Rsupp fixed Cc is made small, the suppressor voltage will have risen to a value such that plate current can flow before C has had time to fully charge. The amplitude of the output will then be low.

OSCILLATOR FREQUENCY

On the other hand, if the value of Cc is made large C will be charged before the plate current starts to flow and the flyback time will be needlessly long.

The frequency of oscillation is determined by C and R principally but from the foregoing it is obvious that Cc and Rsupp could have some effect. The frequency can be changed either by varying the value of C or the value of R. In this instrument C is used

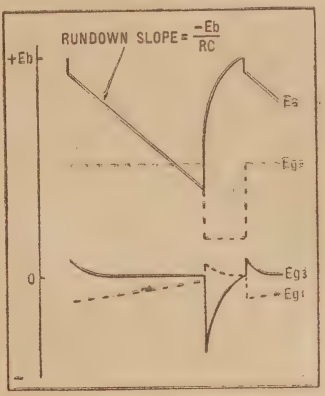


A basic circuit for understanding the operation of the Miller/transitron sawtooth generator. A description is included in the text.

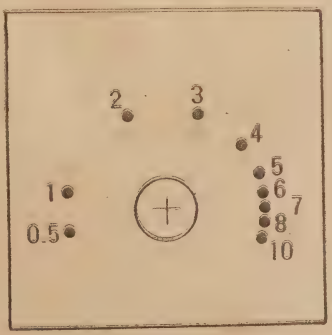
to set the range and the resistance is varied for fine frequency control.

With the circuit values given, the range of the fine frequency control is greater than 10 to 1. Values of C are chosen so that each range is related to the next by a ratio of 10 to 1. Thus a single scale serves for frequency calibration.

In order that the best compromise between flyback time and amplitude



Typical waveforms for the above circuit. Details will vary according to the relative values of components.



Calibration of the fine frequency control. This applies for a linear potentiometer only.

may be chosen, it is necessary to have a different value of Cc for each value of C, and therefore an extra switching operation is involved. This is a minor complication because the extra contacts are available on the standard switch bank in any case.

A certain amount of selection will be necessary in order to make the ranges fall exactly in the ratio of 10 to one. Our suggestion is that the .035 uF unit be made up of .02, .01 and .005 uF capacitors taken from stock and connected in parallel.

CALIBRATION

The scale can then be calibrated with the aid of, say, an audio signal generator. We have given an example of a typical scale when a linear potentiometer is used. Logarithmic pots are more plentiful and could be used, but the scale would tend to be even more crowded at the high frequency end. Pots with a reverse taper would result in a more nearly linear scale but although they are listed in manufacturer's data they can usually only be obtained to special order. The engraved panel which will be available through trade channels is calibrated for a linear pot.

Bear in mind that the time base cannot by any stretch of the imagination be considered as an accurate standard of frequency, no matter how carefully it is calibrated initially. At the same time it is often very handy to be able to read off the approximate frequency.

Bear in mind also that the frequency of oscillation is affected by the synchronising circuits and that best accuracy will be obtained with the synchronising control turned full off.

If you are using a pre-calibrated panel, it will be necessary to judge the positions of the knob and the value of the capacitor to make the calibrations correct.

For the 100 c/s to 1000 c/s range a stock .005 uF capacitor may prove a little too large, but you should not have too much difficulty in choosing a series capacitor to give the correct range.

MAKING UP VALUES

The required 300 pF approx. for the 1000 c/s to 10,000 c/s range can be made up of 250 pF and 50 pF units in parallel. In practice this may prove a little too small, and a 3-30 pF trimmer can be wired in parallel and adjusted for the correct range.

Finally, there should be no difficulty in getting the required coverage with a stock 25 pF unit and a 3-30 pF trimmer in parallel in the case of the top range.

No adjustment of the capacitors between screen and suppressor is required. Standard units with a plus or minus 20 pc tolerance may be used.

You will note from the waveform diagram this page that the screen voltage goes negative during the flyback period. By capacitively coupling the screen to the first grid of the cathode ray tube the electron beam can be cut off during the flyback period so that the return trace does not appear on the screen.

The waveforms given are idealised and in fact the screen voltage may not

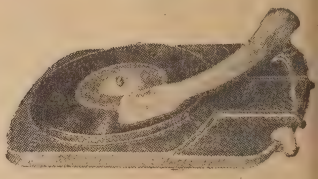
Dual

Introducing the Latest Dual Development

A sturdy, compact 4-speed record player with full sound reproduction.

This record player retains the same quality and performance of larger DUAL models but has been specially designed to be built into cabinets, consoles or portables where space is limited -- -- -- -- £18/10/-

RECORD PLAYER 295



£18/10/-

AUTO PLAYER 280

FEATURES

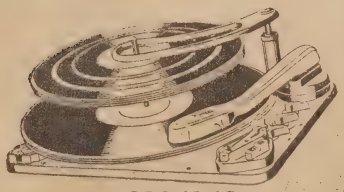
Patented roller for the determination of all record sizes from 6in to 12in. Starting buttons combined with automatic sapphire stylus selector "M" or "N". Fully automatic Pickup movement. Automatic locking of the Pickup and Tonearm in the rest position.

£26/-/6

DUAL 280 changes automatically a records with large centre holes, in con junction with the large centre spindl supplied with each unit. DUAL wid range crystal cartridge CDS 2/3, th incomparable new Pickup for wid range reproduction and minimum re cord wear.

The two-step filter switch is ideal fo older records.

CHANGER 1003 incorporates these extra features:—



£37/9/6

The pause switch makes possible intermissions of from 1 to 4 minutes between records.

Repeat Switch. This makes it possible to listen once again to the record that has just been played.

STOP—When pressing this button, the tone arm immediately returns to its rest position. Locks and switches the entire unit off.

Players and Changers are assembled, marketed and serviced by:

FRED A. FALK & CO
PTY. LTD.
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TELEGRAMS & CABLES: "GRAMOFALK, SYDNEY" ★ PHONE: LX 4783

You'll need a PLATTERBACK

main constant throughout the forward ace. To ensure that the intensity of e forward trace is constant a clipping rcuit using a germanium diode type A85 is included.

It is necessary to choose a compromise value for the coupling capacitor to the CRT grid because of the pple in the EHT supply. Ordinarily oth the grid and cathode of the CRT oat together with the hum voltage nd a moderate amount of hum does ot result in any ill effects.

On the other hand when the internal npedance of the grid circuit is artificially increased and then bypassed to point with a relatively low impedance ground, the hum in the EHT circuit irtually all appears between grid and athode of the cathode ray tube. The lectron beam is then modulated by he hum and the overall effect is most ndesirable.

The obvious cure is to improve the iltering of the EHT supply. It is not rofitable to increase the internal resistance of the supply, say, by placing esistance in series with the rectifier alve, and even a small inductance filter hoke would be an expensive and special tem because of the high voltage insulation.

FILTERING

Another high voltage paper capacitor n conjunction with a relatively small esistor would improve the filtering to he required degree, the objection being hat .5 uF or 1.0 uF paper capacitors ated at 2000 volts are bulky and expensive.

We have used 50 pF (two 100 pF mica capacitors in series) for flyback suppression. This does not result in noticeable beam modulation and gives complete flyback blackout on all except he low frequency range of the time base. The visible flyback on the low frequency range is not really objectionable and appears on one side of the screen only.

There is an arrangement involving only a few small components which should enable the residual flyback to be removed. We may have an opportunity to try it at a later date in which case the results will be published.

Synchronising signals are fed into the suppressor grid of the 6BX6. If the natural frequency of the time base is set a little lower than the frequency of the incoming signal, it can be brought exactly into step by feeding a positive going pulse into the suppressor toward the end of each cycle.

SYNCHRONISING

Special shaping and synchronising amplifiers are employed in some of the better quality instruments and with careful design completely automatic synchronisation can be obtained down to very low pattern amplitudes.

There is no denying the convenience of such a system, but the effort involved in installing the extra circuits is out of proportion to the advantages.

For this reason we have taken the synchronising signal from the output circuits. Small bypass capacitors across the series limiting resistors are necessary in order to ensure good synchronisation at high frequencies. These increase the stray capacitance to earth but the increase is a small percentage of the total.

The amplitude of the synchronising signal can be varied by means of the control brought out to the front panel. It will frequently be quite convenient to leave the control set at maximum with the component values specified on page 73 of the February issue. In some cases full sync. will cause the pattern width to be reduced and a lower setting will be desirable.

When the 6BX6 is switched to behave as an amplifier there is an undesirable interaction between the horizontal and vertical circuits with the sync. control turned on. It should always be turned fully off when feeding an external signal into the horizontal amplifier.

No special precautions were taken in the case of the horizontal amplifier in order to improve the frequency response. Feedback taken from a small load resistor in the plate circuit of the cathode follower to the cathode circuit of the 6BX6 is included mainly to remove amplitude distortion when handling low and medium frequency sine waves.

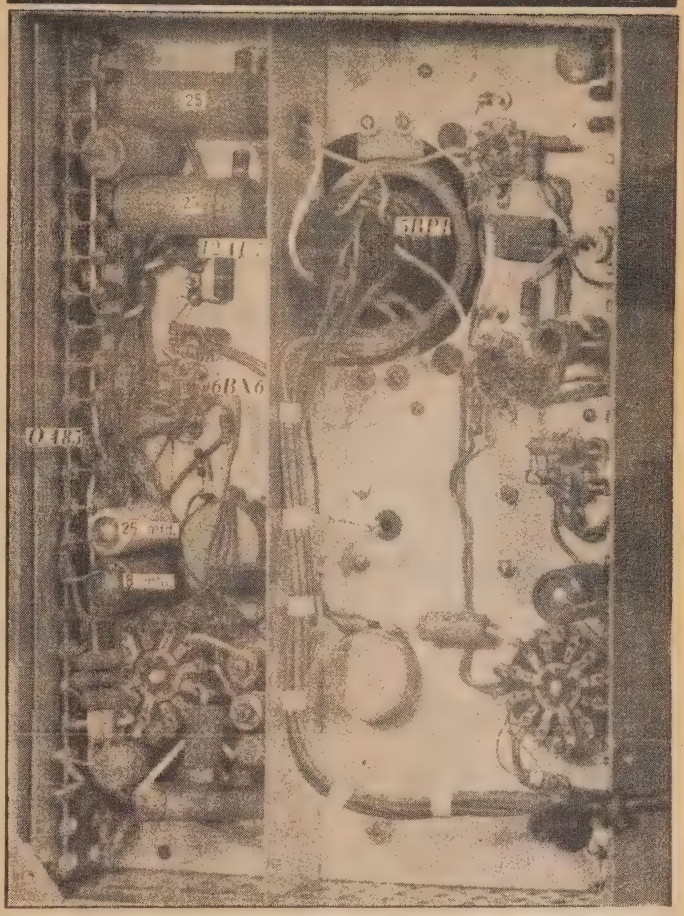
For example, when using the oscilloscope for the visual alignment of television receivers, a signal at sweep repitition frequency (frequently 50 c/s sine wave) will be fed into the horizontal amplifier. Any improvements to the response at extremely high and low frequencies are purely incidental.

It so happens that the curve is level down to a few c/s at the low frequency end. At high frequencies, with the gain control turned full on, the minus 3 db point occurs at about 100 Kc/s. Because of the high resistance potentiometer, the effect of stray capacitance is drastic and the minus 3 db point at the halfway setting is at about 10 Kc/s.

Both horizontal and vertical amplifiers are very sensitive to hum and precautions are therefore taken to ensure that hum does not result in deterioration of the pattern. These take the form of decoupling circuits which, in addition to giving extra filtering, minimise, coupling horizontal and vertical deflection circuits.

(Continued on Page 77)

TIME BASE PARTS IDENTIFIED



A mounting strip down the side of the vertical chassis supports most of the small wiring components. The shield between the time base and vertical amplifier compartments is essential to prevent mutual interaction.

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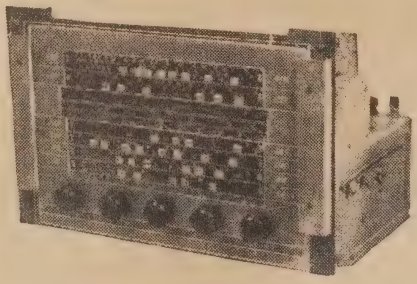
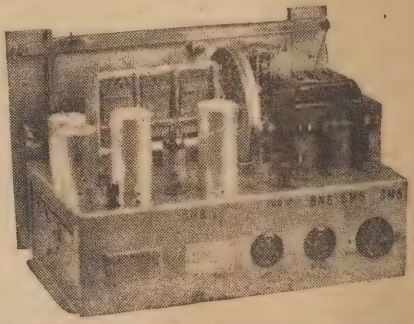
Frequency Response 40 to 13,000 Cycles — Max. Output 10 Watts.





NEW • Ultra modern circuit using nine high gain valves including "magic eye" tuning indicator. Permatuned iron cored coils and intermediates giving excellent interstate reception and a short wave range of 12,000 miles. All valves used are the new Philips nine pin innoval series.

NEW • Tone control and audio stages incorporating the Mullard 5/10 amplifier circuit with separate bass and treble controls giving + or — 15db. boost or cut at 50 cycles L.F. and 10,000 cycles H.F., combined with push-pull output with inverse feed-back gives you really high fidelity reproduction from your radio or favorite recordings.

NEW • Dual speaker combination using a heavy duty woofer (12in M.S.P. Jensen AU54 special) with matching 6in tweeter and cross-over network giving a frequency response of 46 to 13,000 cycles. Speakers are mounted coaxially making only one 11in mounting hole necessary. If required the new Magnavox high fidelity twin coned speaker can be supplied.

NEW • Large calibrated edge-lit dial in plate glass (11in x 7in) with main stations of each State in prominent type. Dial fitted with counterweight drive giving smooth tuning. Indicator lights are fitted showing which band is in operation. Dial can be supplied in cream, black or brown with matching knobs and escutcheon to suit contemporary blond or walnut finished cabinets.

NEW • Sensitive "magic eye" tuning indicator (EM80) making tuning simple and positive even on interstate, overseas and country stations.

All chassis are wired for the fitting of an F.M. tuner or tape recorder, special plug being provided on back of chassis, also pick-up terminals and outlet for grammo motor. Power switch is fitted to volume control, radiogram switch combining with wave change switch. Audio end of set can be used with T.V. receiver if required.

ALL CHASSIS GUARANTEED FOR A PERIOD OF 6 MONTHS

A New 10-Valve Dual-Wave Radiogram Chassis

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The ideal chassis for those difficult locations where reception is doubtful. Specifications as nine valve unit but with the addition of high gain tuned R.F. stage giving greater sensitivity and selectivity on both broadcast and short wave bands.

£42/15/- F.O.R.

Write for full specifications

RECORD PLAYERS AND CHANGERS

We have a complete range of 3-speed record playing equipment, including Dual, Collaro or Garrard Players, with turn-over crystal pick-ups or your choice of Garrard, Stromberg-Carlson, Collaro or the new Dual 3-speed changer that will play 7, 10 or 12in record intermixed. All changers have turn-over Crystal pick-ups.

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A READER BUILT IT!

Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.

BATTERY TEST CIRCUITS FOR JUNIOR MULTIMETER

The terminal voltage, measured with a high resistance voltmeter, does not give a clear indication of the condition of dry batteries. This month's contributor suggests some minor additions to the "Junior Multimeter" which allow a suitable load to be applied to the battery at the same time as the voltage is measured.

THE suggestion comes from Mr. R. H. Channon, of Amity Point, Queensland. The important points are set out clearly in Mr. Channon's letter.

"The accompanying additions to the 'Junior Multimeter' (R, TV and H, September 1954, should be helpful in the servicing of battery portables.

"An additional switch point is wired for a 1.5 volt scale. (I am using a 10 position switch.) Also, extra spring contacts are wired behind the jacks as shown, to contact with long "Clix" plugs to the positive circuit leg. There are two extra jacks, one each for the A and B battery tests.

LOAD OPTIONAL

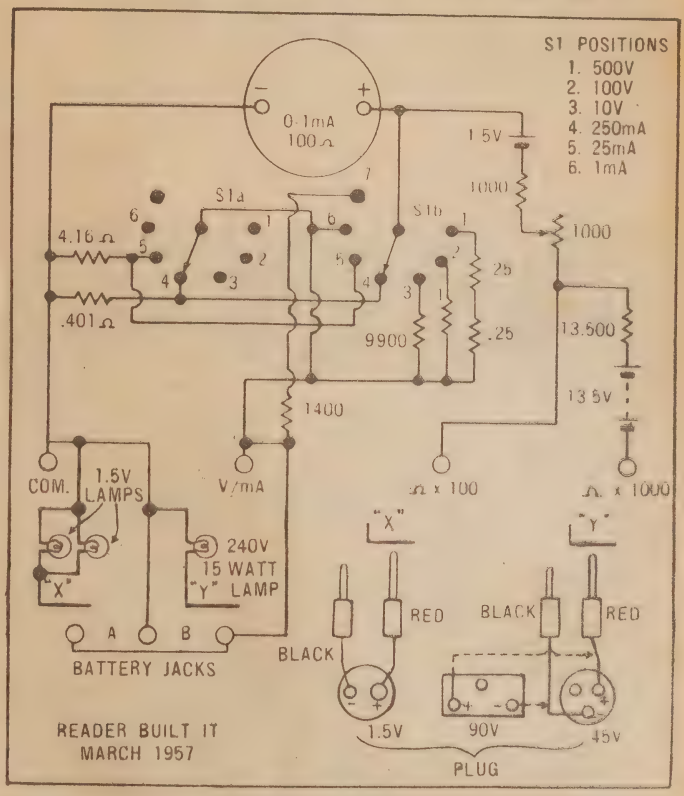
"The spring is connected to the load in each case and when the long plug is pushed right in the battery is tested under approximately working conditions. When the plug is withdrawn slightly the load is taken off. Normal plugs are not long enough to reach this spring and are used for other than battery tests.

"I find that a great saving in time can be made by making special cords for the particular battery under test.

"I have other switch points wired for other tests quite apart from the subject of this discussion."

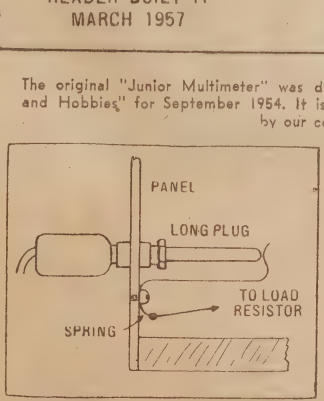
Mr. Channon's suggestion obviously can be applied to other multimeters and the readers will have difficulty in working out suitable circuit additions.

A 50-volt scale allows a convenient selection when checking a nominal 45-volt battery but if you are called upon to check a number of 67.5-volt batteries, a 100-volt scale is more suitable.



The original "Junior Multimeter" was described in the issue of "Radio, Television and Hobbies" for September 1954. It is redrawn here with the additions suggested by our correspondent.

BLUE diamonds are extremely rare in nature, but atomic scientists have found a way to color colorless diamonds blue. Electron bombardment produces a colored layer some fractions of millimetres deep on the surface of the crystal. This difference from the genuine stone can only be seen on very close examination and cannot be detected in jewellery. Naturally blue diamonds are colored throughout.



Plug makes contact with load only when pushed right in

USING FAULTY FLUORESCENT LAMPS

MR. B. SARGENT, of Earlwood, NSW, suggests operating fluorescent tubes with burnt-out filaments from the secondary winding of a radio transformer.

Join the filament pins at each end and in the case of a 40-watt tube connect it across the total secondary of a 385-volt per side transformer. A resistance will be needed to limit the current when the tube is conducting. A 60 watt, 240 volt lamp is suitable.

The most notable advance in Sound Recording

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Extra Play

SOUND RECORDING TAPE

with the new patented silicone lubrication process

- *50% Extra playing time*
- *Reduced magnetic headwea*
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In this exclusive "SCOTCH Brand silicone lubrication pro cess, the silicone is actually im pregnated throughout the tap and forms a protective film be tween the tape and the magneti head.

The new patented silicone lubri cation process . . .

- Reduces friction in the recorder.
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- No excess of lubrication to wipe fro capstans or the reel.
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* Another "SCOTCH" Soun Recording Tape FIRST.

"SCOTCH" Brand Extra Play Sound Recording Tape is an entirely new tape with outstanding advantages for every application of Sound Recording. The new thin construction enables 50% extra tape to be wound on to any spool, giving for example 1800 ft. on the standard 7 in. plastic spool. The magnetic coating is new with a high standard of uniformity, excellent sensitivity and output for a given distortion. The high frequency response is even better than "SCOTCH" Brand Sound Recording Tape type 111 to the extent of about 2 db at wavelength of 0.5 mil. A very tough and flexibl Polyester base is used for "SCOTCH" Brand Extra Play Sound Recording Tape which has outstandin mechanical properties over a wide range of tem peratures and humidities. These exceptional prope ties make "SCOTCH" Brand Extra Play Soun Recording Tape a notable advance in the field of Sound Recording.

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TRADE REVIEWS AND RELEASES

ORPHEUS T-TABLE S SMOOTH AND SILENT

It has always been difficult to find a really good turntable the price of which is not astronomically high. Modern records demand a completely smooth and silent unit, so that the owner of hi-fi equipment is posed with a problem to reconcile quality with reasonable cost. A turntable which will allow him to do this must always arouse our interest.

WILLIAM WILLIS and Co. Pty., Ltd., Victorian distributors for the rpheus turntable, have sent us a mple for test, and after some weeks of e it appears to line up well with the aker's claims for it.

The entire assembly is carried on a se plate of sand-cast aluminium, heavy ough to form a completely rigid ount. It fastens to the motor board y means of concealed screws which run to holes beneath the base plate, which easures 15¼ by 14½ inches.

The turntable is of non-ferrous metal, 2 inches in diameter, and of adequate eight to provide good flywheel action. s 6½lb is supported on a single ball eneath the spindle, which is hardened nd ground between centres for high ac- racy.

It fits to the turntable with a 10-degree aper for easy removal, and runs in ilite bearings. The turntable weight is oncentrated at the periphery, and it is riven by a resilient rubber belt run- ing around its outer edge.

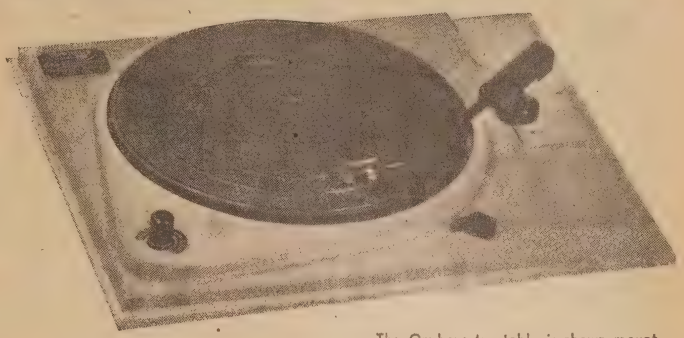
The turntable bearing is at the centre f a frame having three arms, the extre- ities of which are hung from the base t adjustable rubber insulated points.

The base plate carries the motor, also ung in rubber mounts. The motor drives he table through a drive-wheel which as an outside groove to accommodate he belt. The wheel is fitted with a ubber tyre which engages the three-step ulley on the motor shaft, and a plunger- ype speed change knob moves the drive- wheel up or down to select the correct peed.

An ingenious link is associated with he on-off switch, so that, when the motor s switched off, the drive-wheel is lifted rom the pulley.

The speed-change plunger also has a otary movement to provide small hanges in speed. The variation is 3 pc. nd holds for all three speeds.

The motor is a four-pole unit, with a lynamically balanced armature.



The Orpheus turntable is shown mounted on a board with a test pickup in place. Speed selector is at the left and switch at the right. The pickup normally bolts to the base plate.

Our tests with this turntable showed it to be virtually noiseless in operation, with no discernable vibration at the base plate—one of the smoothest we have used so far. To avoid drilling holes in the base plate where the pick-up normally stands, we provided a wooden block on the motor-board upon which we mounted several pick-ups. Even with this rough method there appeared to be no vibration transmitted to the stylus point.

After some hours of use, the motor itself becomes quite warm on 240 volts AC, but it is adequately ventilated. It has plenty of torque, and it would be quite permissible to reduce voltage to approximately 200 with no ill-effect and a cooler motor. The temperature rise is not excessive.

A feature of the rubber mat fitted to the turntable is a series of concentric rings intended to engage discs of various diameters at their outer edges. There is ample clearance for 16-inch discs to be used with suitable pick-up arms.

SAND-FILLED PANEL FOR SPEAKERS

AS a means of baffling a sizeable modern loud-speaker, enclosures of various kinds have much to recommend them. But one of the biggest problems has been to construct such enclosures in a rigid manner which will resist the air pressures concerned without vibration.

All the best methods—the use of brick, concrete, etc.—have many obvious disadvantages. But, as Mr. G. A. Briggs, of Wharfedale, has generally convinced the world, a very near second-best can be achieved by using double plywood panels and filling the space between them with dry sand.

If the speaker is used in a room with solid brick or plaster walls, a complete box is not needed. By making a front panel and top of suitable dimensions, and fitting these into a corner, the walls and floor can be used to complete the box.

A version of such a panel, recently submitted for test by Amplasound, worked extremely well. It was built to Briggs' specifications—40 by 36½ inches—and was used with a Wharfedale 15-inch bass speaker.

Results were noticeably cleaner and sharper in the lower registers than when using an enclosure of about the same capacity, and the space occupied by the system fitted into the room corner effectively less.

Available in walnut and maple, the hand-polished panels cost £27, and can be obtained for either 12 or 15-inch speakers.

The Amplasound panel in use. The upper cabinet holds middle and high frequency speakers.

Ferguson

R.T.&H. KITSETS

BUILDING YOUR OWN?

No matter what equipment you intend to build you will find suitable transformers and chokes in the extensive Ferguson range.

Here are the FERGUSON Components for equipments described in R. T. & H in 1956.

EQUIPMENT		POWER TRANSF.	CHOKE	OUTPUT TRANSF.
MULTI BAND 6	JAN. '56	PF170	CF105	—
CRYSTAL PLAYMASTER No. 13	JAN. '56	PF151 or PF170	CF103 or CF10R	OP24
MANTEL 3	FEB. '56	PF619	CF102	—
D/W BASIC FIVE	FEB. '56	PF151F	CF102	—
BASIC FOUR	MAR. '56	PF201	CF102	—
PLAYMASTER AUX. PWR. SUPPLY	MAR. '56	PF201	CF102	—
BASIC AMPLIFIER	APRIL '56	PF170 or PF130	CF104 or CF107	OP4,63 64,65 etc.
SIGNAL INJECTOR	APRIL '56	PF619	—	—
MODULATOR & POWER SUPPLY	MAY '56	PF152 & PF130	CF106	MT118
PHOTO TIMER	AUG. '56	PF619	—	—
LITTLE GENERAL FOR 1956	AUG. '56	PF201	—	—
BATTERY CHARGER	SEPT. '56	PF265	—	—
PERSONAL POWER SUPPLY	OCT. '56	PF619	CF102 (2) CF115	—
"1956 KARSET" VIB. SUPPLY	NOV. '56	VT209(12V) or VT104(6V) or VT254*	CF102	
"57 PORTABLE" POWER SUPPLY	DEC. '56	PF201	CF105 or CF102	—

* VT254 is a universal vibrator transformer for 6V or 12V operation — **JUST RELEASED**

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PRECISE SYSTEM OF NAVIGATION

SAGOING observatories will permit the navy's experimental ship Com- Island to know its exact position any time without any help what- from shore-based installations.

The special ships inertial navigational em (SINS) which the Compass d is testing determines latitude and itude, true north and the ship's d over the bottom.

The navy's chief interest in such a em is for use in missile ships, whose ation must be known very exactly permit them to launch a ballistic sile at a target whose coordinates are wn, but it may also prove of value all shipping.

UTOMATIC TRACKING

The miniature observatories, or celes- trackers, once pointed toward venly bodies, will automatically k them, giving information for use checking and correcting the SINS.

The trackers are mounted on a rigid er isolated from ship flexures to e fixed reference planes for celestial nputations. For further stabilisation, cial activated fins counteract roll so t the ship rolls only about 1.5 degrees ere without the automatic fins the l would be 10 times as great.

Both the servo-operated fins (which, identally, make the Compass Island most comfortable ship in the navy) d the inertial navigational system were developed by branches of the Sperry Gyroscope Co.

Ship's speed is indicated by a special sonar in a large streamlined dome attached to the ship's hull. This system was developed by the navy's Bureau of Ships and General Electric.

The sonar dome earned the Compass Island the shipyard title of "ship with the droop snoot".

Smoke seals planes

CIGARETTE smoke plugs up aircraft —actually tightens the seal of pressurised cabins. But it also fouls up instruments.

Recently when a new air transport was delivered, according to Flight Safety Foundation, in USA a test showed a leakage through the pressurised shell of 190 cubic feet a minute.

However, with the passage of time and millions of cubic feet of smoke-laden air, the tobacco tars lowered the leakage to a mere 90 cubic feet a minute.

Of course, says the foundation, the tars also fouled up the orifices that meter out the exhaust air, so the transport operators now are experimenting with filters on cabin pressure regulators.

It has long been known that tobacco tars have affected flying instruments— even blind-flying instruments — and aeroplane manufacturers are constantly designing to overcome smoke-tar accumulations.

PHILIPS BIG TRANSMITTING VALVE

The tube illustrated is a Philips Miniwatt type QBL5/3500 medium power forced air-cooled transmitting tetrode. In a typical installation the modulated amplifier comprises two Type QBL5/-3500 tubes arranged in push-pull for grid modulated Class C television service, capable of producing 5000W. output at the peak of synchronisation. This stage can be connected to the output feeder but in the majority of transmitters it is followed by a linear amplifier to produce a final output power of 10,000W.

In the FM sound transmitter two Type QBL5/3500 tubes are employed as a Class C RF power amplifier to give an output power of 2000W.

Maximum ratings for the QBL5/3500 apply up to 220 mc/s, the highest frequency encountered in current Australian television practice.

THE MYSTERY OF LIVING CELLS

(Continued from Page 17)

nually being neutralised by the potas- ium.

In order to keep the process going rbonic acid must be continually re- enished. This is done because the ll is respiring like any other cell by king in oxygen and sugar which burns release energy and carbon dioxide. he latter dissolves in the sap to form rbonic acid and thus the acidity of e sap is constantly renewed. There thus always acid ready to combine ith the potassium coming from out- de.

Gray likens the acid to a chemical ump sucking the potassium in from utside. The acid would combine with odium if that chemical could get in ut because of the greater penetrating ower of potassium that does not occur.

Dr. Osterhout tested his theory with classical model constructed in the ollowing manner.

He took a glass beaker. Into the bot- om he poured a 2in layer of a mixture f guaiacol and cresol giving an oily ayer to simulate the oily layer of the alonia cell. This contained no water, vas impervious to water and contained n acid.

He lowered a section of glass tube nto the oily layer so that the bottom nd just penetrated it. Into this he oured water in which was dissolved arbonic acid gas. The water simulated he acid sap of the valonia.

Around the glass tube he poured in artificial sea water. Since the wall of the glass tube acted as a barrier between the artificial sap and the surrounding artificial sea water it followed that if any of the alkali salts of the artificial water was to combine with the acid of the artificial protoplasm they should pass through the oily layer at the bottom and up into the artificial sap through the open bottom end of the glass tube.

That is what happened. At first potassium and sodium collected in the artificial sap but the potassium increased in concentration more rapidly than the sodium. The acidity of the artificial sap was maintained by bubbling carbonic acid gas into it through a glass tube. After a time the artificial cell reached a state of equilibrium where the concentration of potassium and sodium reached a fixed ratio to the water of the sap.

That is exactly what happens in the valonia cell and Dr. Osterhoust's theory was proved.

Other scientists have made models to simulate many processes of the human and vegetable cell. By doing so they have added greatly to our knowledge of living processes and brought closer the time when perhaps the individuality of the living being will be understood sufficiently to enable that age-old dream to be realised namely the renewing of diseased and useless organs.

AWA RONETTE
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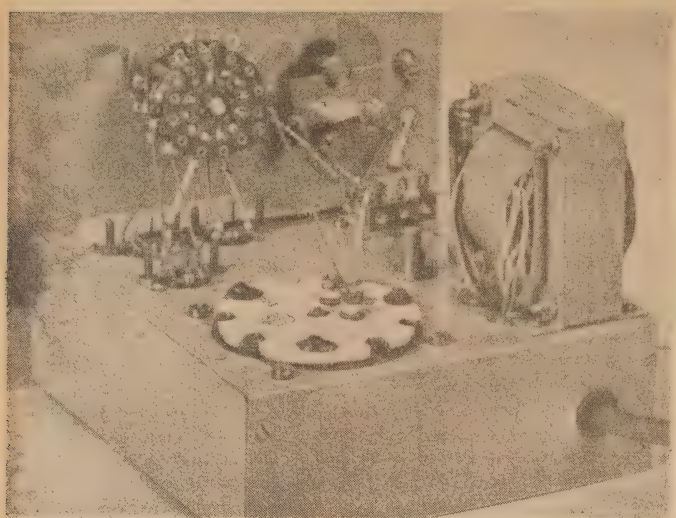
Type 088/F
£9'5'11
Complete with flexible arm.
Technical pamphlets will be mailed on request. Other types also available from
Newton McLaren Ltd.
17 Leigh St., ADELAIDE
and leading wholesalers.



A rear view of the unit showing the layout above the chassis. The top of the mechanical modulator is in the left foreground, with the phase control pot to the right of it. Underside of the 6CB6 socket is behind the 3 tag terminal strip.

A MECHANICAL FM WOBBULATOR

Here is a practical version of an FM generator recently suggested in an overseas magazine. If you are keen on TV and FM experiments this should provide an excellent piece of test equipment with which to enter this field. It may be built as a single unit or as part of a complete sweep and marker generator.

by Philip Watson

AS most experimenters fully appreciate, the advent of TV has brought with it the need for a completely different approach to alignment procedures. The simple peaking of successive stages to a single frequency is no longer adequate, the requirements of specific bandwidth and "shape" making it necessary to use an FM generator and CRO. To a lesser extent these remarks also apply to FM.

While almost any CRO will have suitable characteristics, the provision of a suitable FM generator looked like presenting a serious problem until recently. Then we came across an article in Wireless World suggesting how a simple unit could be made by employing a particular piece of disposals gear. It looked so good that we reprinted the article in the January, 1957, issue, then set to work to build a version suited to local conditions and components.

WIDE INTEREST

In the meantime, the reprint had created considerable interest and many readers approached us for additional information. For this reason we are publishing all the results of our work thus far, at the same time pointing out that the final form which the instrument takes may yet vary from this design. However, it should provide an excellent starting point, even assuming some changes later on.

Having obtained the specified piece of disposals gear—not without some searching through the local disposals stores, we admit — we first mocked up a circuit along the lines of the original. With this as a basis, we conducted a number of interesting experiments, which led to some useful additions and modifications.

ORIGINAL WORKED

In fairness to the author of the Wireless World article, we must emphasise that the original circuit worked in the manner claimed for it. Such modifications as we suggest are either optional or brought about by local requirements.

Our first impression of the original circuit was that the return trace suppression was not as effective as we would have liked. We had no difficulty in making it work, but it was really not as effective when the overall brightness of the trace was reduced to what we considered an inconveniently low level.

This may well be due to the characteristics of the 5BP1, in particular the control grid sensitivity, which may not be as high as for the tube used in the original experiments. However, in view of the popularity of the 5BP1, we felt it was essential to ensure satisfactory operation with it.

At the same time there arose the question of how best to couple the suppression voltage into the CRT grid. In typical circuits, including our own, it is usual to operate the CRT anode at chassis potential, with the cathode negative by the EHT voltage. This means that the grid is also negative to the chassis by approximately this amount, usually about 2000 volts.

Not only must this voltage be kept out of the generator circuit, but precautions must also be taken to protect the operator from unpleasant or even dangerous "bites".

Although we subsequently developed an internal return trace suppression circuit we feel that the experiments made are sufficiently interesting to justify passing on to readers.

If you wish to use this method of suppression we suggest that the CRT grid be brought out to a suitable panel terminal through an isolating capacitor of at least 2000-volt rating. The exact value is not critical and something around .1 mfd appears to be quite satisfactory. In addition, the panel terminal should have a "bleed" resistor between itself and chassis to prevent the capacitor acquiring a charge equal to the EHT voltage.

We overcame the lack of suppression voltage by simply modifying the phase shift component values and taking the suppression voltage from the 150-volt HT winding of the power transformer. This arrangement gives ample voltage for the 5BP1 and, we imagine, any other similar tube.

BUILT-IN SUPPRESSION

While this arrangement works very satisfactorily and we used it for large number of tests, we still felt that a "built in" suppression circuit would offer worthwhile advantages if it could be provided without undue circuit complexity. For one thing, such a scheme makes the instrument independent of the type of CRO used, since it need no longer have the grid accessible.

Another point concerns the usefulness of the display. With an interna

pression circuit the return trace is
blacked out, but merely deprived of
rmation. It thus provides a base line
h serves as a useful reference when
ing the symmetry or other charac-
tics of a pattern.

nce we had already provided a nega-
pulse suitably phased to coincide
the unwanted return trace, it seemed
gical step to apply this to some part
he internal circuitry in such a way
either block off the oscillator from
attenuator or to actually stop the
lator itself.

e had some misgivings about the
r idea, since there seemed to be a
ibility that the oscillator might not
again reliably in time for each for-
l trace or might even tend to shift
requency slightly from one trace to
next.

hen, for other reasons, we decided
se a pentode valve, it seemed logi-
to apply the suppression voltage to
suppressor grid with the idea of iso-
g the oscillator portion of the valve
out actually stopping the oscillation
scheme showed promise, but failed
e a low output was required in con-
tion with a sensitive circuit. In such
s it proved impossible to control the
age from the instrument sufficiently
this tended to bypass our blocking
rit.

FITE FORCE

ccordingly, we decided to try sup-
sing the actual oscillation. This was
by simply returning the grid leak
he phase-shift network instead of to
. This proved to be completely ef-
ve and our fears regarding oscilla-
instability proved to be quite un-
ded. However, we found it neces-
to set the phase shift potentiometer
y exactly, otherwise part of the
ted trace may be suppressed.

hen we first tried this circuit we
saged the need for a rectifier of
e kind, such as a germanium diode
prevent a positive voltage from be-
applied to the grid during the active
of the cycle. Experiment showed
to be unnecessary, the use of a
value of grid leak being sufficient
revent the positive voltage from ris-
unduly as soon as the grid com-
ced to conduct.

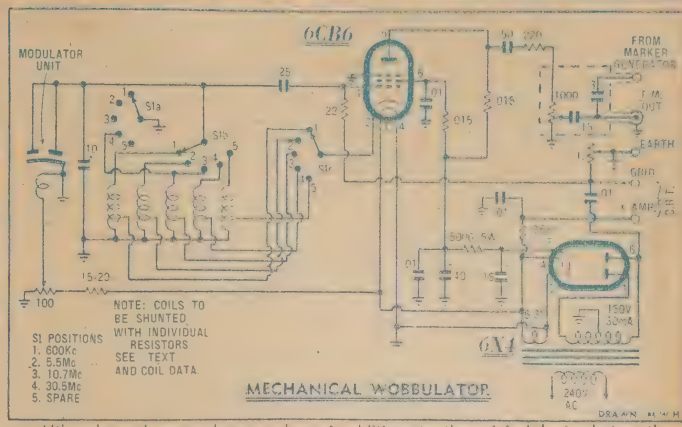
he component values for the phase
network are the same whether the
pression is internal or external, and
circuit shows (dotted) the appropri-
terminal if the external system
uld be preferred.

T TRACE

inally, we noted that one of the
es was more linear than the other.
may be simply a characteristic of
particular unit, but we suggest it
ld be worthwhile to check on this
t and arrange the suppression circuit
hat the least desirable trace is sup-
sed. This is merely a matter of
cting one or other ends of the HT
ndary winding, as determined experi-
tally.

nother problem we encountered con-
ed the waveform of the mains volt-
This is normally reasonably pure
in any case, is not particularly im-
ant, since low order harmonics (2nd,
etc.) can be easily followed by the
ing coil of the wobbulator unit. Thus

CIRCUIT IS STILL SIMPLE



Although we have made a number of additions to the original basic design, the circuit is still simple. Note the use of the electron coupled circuit, the internal return trace suppression, and the modified sweep control. Other valve types are discussed in the text.

the horizontal trace remains an accurate picture of the frequency deviation.

Our trouble commenced when the pattern we were displaying—that of an FM discriminator, as it so happened—suddenly became so badly distorted that we immediately suspected trouble in the discriminator. We spent some time fruitlessly checking possible causes, until the trouble suddenly vanished as mysteriously as it had appeared.

Thinking the problem over, we considered the possibility of mains distortion, and the next time it happened we were ready with another CRO to check our theory. Sure enough, the display showed the most atrocious distortion, being in the form of small saw tooth pattern near each peak. It obviously represented frequencies much higher than one could reasonably expect the wobbulator to follow though, of course, the time base of the display followed it quite accurately.

When the mains distortion suddenly vanished and the discriminator pattern came good at the same instant, we considered the point proved. The next thing was to find a way of overcoming it.

A filter in the time base voltage supply, and which would approximately match the mechanical limitations of the wobbulator unit, seemed to be a logical approach. We worked out a simple filter network consisting of a .068 meg resistor and a .01 mfd capacitor which should become effective around the 10th harmonic and beyond.

This proved completely effective in our case, though we cannot guarantee that it is absolutely optimum. However, if trouble of this type is still encountered, there is no reason why more or less filtering may not be tried. The main limi-

PARTS LIST

1 R.T. & H. instrument case.
1 Chassis 6in. x 6⅝in. x 2in.
1 Power transformer 150V 30ma 6.3V 2A
1 Modulator unit from APN-1 Altimeter
1 2x2x5 switch or 1 2x1x5 switch with rear shorting plates.
1 Single contact mic. plug and socket Types C/1/02M & C/1/01F
2 Terminals (black and red)
3 Coil formers with iron cores. M04 or similar.
1 6X4 valve
1 6CB6 valve
1 Miniature 7 pin socket (plain)
1 Miniature 7 pin socket (shielded)

CAPACITORS

1 40 mfd 200V electrolytic
1 16 mfd 350V electrolytic
4 .01 mfd 400V paper
1 50 pf mica
1 25 pf mica
1 15 pf mica
1 10 pf variable
1 3 pf mica

RESISTORS

1 1 meg. potentiometer
1 .22 meg. ½W
1 .068 meg. ½W
2 .015 meg. 1W
1 5000 ohm 5W
2 4700 omh ½W (see text)
1 2200 ohm ½W (see text)
1 1000 ohm potentiometer
1 220 ohm ½W
1 100 ohm potentiometer
1 15 ohm 3W or 1W

MISCELLANEOUS

2 3 terminal tag strip
3 7 terminal tag strips
1 yd PT9M coaxial cable
4 pointer knobs
Copper or brass sheet for attenuator box. 20-22G
2 Core cable
⅜in. grommets
2 alligator clips

Yes, this little capacitor will make BIG savings for You!

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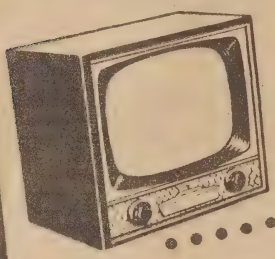
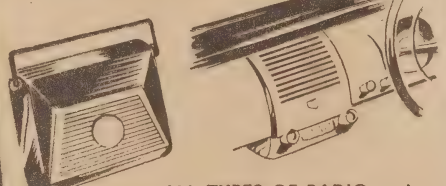
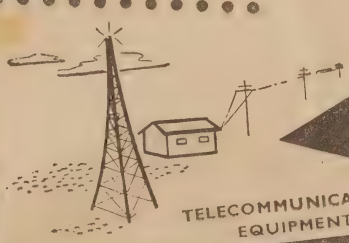


TELEVISION



ALL TYPES OF RADIO, and



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ion appears to be the amount of phase
ift which can be tolerated, plus the fact
at it would not be desirable to suppress
rmonics to which the wobbulator can
spond adequately.

Another modification was the sweep
ntrol in the wobbulator driving coil
cuit. Used as a rheostat, as in the
ginal circuit, there was difficulty in
lucing the sweep to a sufficiently low
fer; a matter of some importance
en harmonic operation is employed.
wiring this to provide a potentiometer
ion increased the available range con-
erably.

IAL AND ERROR

The limiting resistor value may have
be determined experimentally, the
ue being adjusted until the amount of
vement in the unit is just below the
nt where the two capacitor plates can
heard to rattle against each other.

The remaining major modification was
use of a pentode valve in place of
original triode. In most respects the
ode valve worked very well and its use
prompted by the fact that there are
mally four 955's in the altimeter unit.
However, the pentode makes possible
use of a true electron coupled circuit,
ich has some advantages. The main
is the excellent isolation between
oscillator and the output circuit, mak-
the oscillator circuit virtually inde-
ident of external loading, &c.

n particular it helps isolate the marker
energy (derived from a separate
illator) which otherwise interacts with
swept oscillator every time it passes
marker frequency. The result is a
ere distortion of the pattern at this
nt.

n place of the 955 we first tried a 954.
s performed quite satisfactorily and
re is no reason why it should not be
d if it happens to be on hand or
ilable cheaply. The 9001 is an al-
st exact electrical equivalent with a
niature seven-pin base. The 956 and
9003, being variable-mu versions of
954 and 9001, can also be used.

n fact, almost any miniature RF pen-
e should be suitable in this position
we finally settled for the current
e 6CB6. Another is the 6AM6. The
n requirement is that the suppressor
e its own base contact, since this
uld be earthed and not connected to
node.

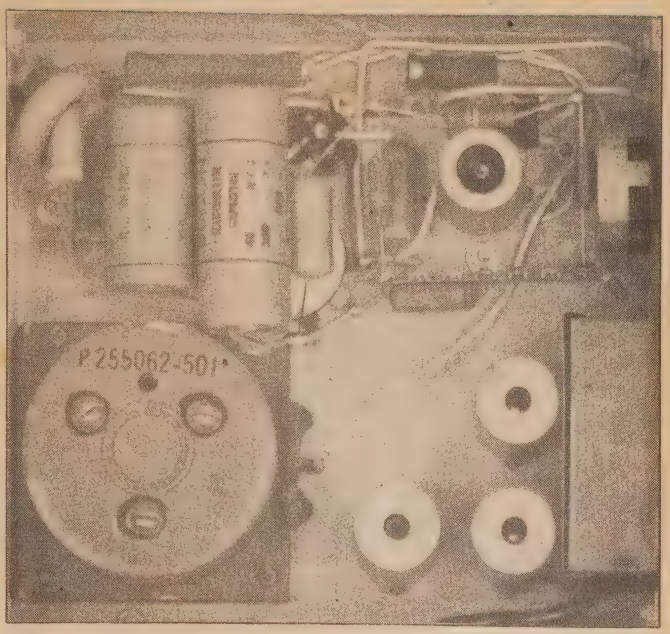
ECTRON COUPLING

At this point a brief explanation of
electron-coupled circuit may be in
er. In this circuit the cathode, grid
screen of the pentode function as
riode in a simple Hartley oscillator
uit. By reason of the Hartley cir-
the plate of this triode (the
en) is at chassis potential as far as
is concerned, thus tending to mini-
e capacitive coupling to the remain-
electrodes.

urther shielding is provided by the
pressor, which is also at chassis po-
ial, so that the connection between
oscillator triode and the external cir-
is virtually via the electron stream
y. The final plate is held at a poten-
similar to, or higher than, the triode
e (screen).

Next point to consider is the ranges
should provide on such an instrument.
least three immediately suggest them-
es: 30.5 Mc, the recommended TV

THE UNDERCHASSIS LAYOUT



The underside of the unit. The mechanical wobbulator is top right, with the coils and attenuator box to the left. The power supply components are at bottom right and the 6BC6 at bottom left. The pot. on the panel is the sweep control.

video IF, 10.7 Mc, the usual FM IF, and 5.5, the TV sound IF. Ideally, it would be very nice to provide coverage of the actual TV channels as well, allowing an overall check on a receiver's performance.

Unfortunately, the total capacitance in the circuit is too high to permit working in the higher frequency channels, though channel 2, 63 to 70 Mc, should present no special difficulty.

In fact, we wound a "coil" for the local FM channel (92.1 Mc) with the idea of providing an overall check for FM tuners. This worked reasonably well, though it was obvious that we were right on the upper limit of frequency. The coil was little more than a length of wire mounted between appropriate switch

COIL DATA

WOUND ON 5/16in DIAMETER FORMERS WITH SINGLE IRON DUST CORE (MO4)

BAND	WIRE	TURNS	TAP	SHUNT
30.5 Mc	24 SWG	7	2.5	2200 Ohms
10.7 Mc	24 SWG	24	8	4700 Ohms
5.5 Mc	31 SWG	60	20	4700 Ohms

contacts, most of the resonant circuit being capacitive.

A better approach might be to use the 9th harmonic from the 10.7 Mc channel or the 3rd harmonic from the 30 Mc channel for the 92.1 Mc band. A fourth coil could then provide a channel to sweep from about 60 to 70 Mc, covering channel 2 directly and channels 7 and 9 on the third harmonic.

Another suggestion is the provision of a 600 Kc channel capable of sweeping over about 25 Kc. This would assist materially in the adjustment of wide-range tuners. At the moment we are looking for a suitable commercial coil which can be modified by the home-builder without too much effort.

SHUNT RESISTORS

While on the subject of the coils it might be opportune to discuss the shunt resistors mentioned in the coil data and circuit. These were introduced to overcome another problem we encountered; that of obtaining constant output over the swept band. Fairly obviously, an instrument of this type would be of little value if the signal strength varied appreciably, since the resultant pattern would be meaningless.

A check showed that the output was, in fact, far from constant, particularly in the 30 Mc band. Further, the response curve varied with the setting of the fine frequency control.

The cause appeared to be various unwanted couplings, circuit losses, etc., which would be too numerous to track down individually. The best approach seemed to be that of swamping these losses by introducing as much artificial loss into the circuit as possible, in this case a resistor shunted across each coil.

In this regard, the use of a high gm valve is to be preferred, since it will allow the circuits to be loaded more heavily without risk of the circuit dropping out of oscillation. In practice, the scheme is very effective.

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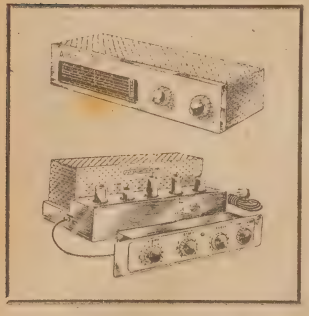

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best values may need to be de
ed experimentally, particularly if
valve types are used. In general,
west resistance value should be
consistent with reliable oscillation
he entire sweep.
check the performance, the output
to the vertical deflection plates of
RO through a simple diode detector
ilter network (see circuit). This
oduce a horizontal trace above the
ne and, ideally, perfectly level and
d with the latter. Our final re-
were very good, only the 30 Mc
showing a slight, but smooth, rise
one end.
ssessing the usefulness of resistor
the instrument should be enclosed
case, since leakage effects can
the true performance.
much, then, for the general design
and the reason for their use. We
now to the practical considerations
physical form and constructional

E OR SMALL

e appeared to be two possible ap-
es. One was to build the FM gen-
only in a small case (such as we
r the R C bridge, one inch CRO,
nd to use an existing generator as
ker generator. The other was to
oth the FM generator and a mark-
erator in one large case, such as
or the senior signal tracer.
ideas have advantages and dis-
ages. The smaller version has the
age of simplicity, but may not be
venient. A separate generator has
provided and set up, plus the fact
may not always cover all the
or channels involved. Harmonics
ays be used, of course, but these
t automatically free from am-
A further problem is the pro-
of a crystal reference for the 5.5
V sound IF, something which is
ly essential.
larger instrument combining both
ns will be more complex, but will
pletely self-contained. A 5.5 Mc
circuit can be built in, while the
generator can be designed to
the required ranges to best ad-
e. For our own requirements at
e considered it the best approach,
we produced only the FM gener-
r the present.
rdingly, we built our instrument
larger case, using about half the
le space and leaving the remainder
marker generator. If you wish
d the FM generator as a separate
ere is no reason why the chassis
and layout could not be modified
to accommodate it in the smaller

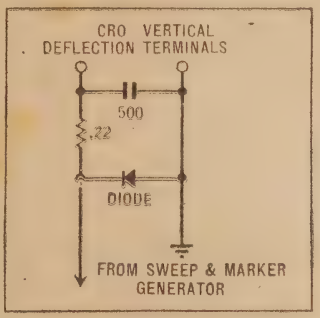
PONENTS

component calling for most com-
s the actual mechanical wobbu-
nit. This is used in a radio alti-
which was made under several
lumbers, but generally embodying
signation, APN-1.
e altimeters have been available
n normal disposals sources and we
and that large numbers have been
the past—mainly for the valves,
otor, and minor bits and pieces.
alue of the wobbulator unit has
en fully appreciated until recently.
plies are not particularly good in
at the time of writing, though
derstand that the position in Mel-
is somewhat better. In short,
ly expect that you may have to

search for one of these units, but it would seem to be worthwhile. Provided the position is fully appreciated, no one should be disappointed.

The unit resembles the magnet of a conventional loud speaker (which it probably is) faced with a ceramic plate holding two terminals. A third terminal is mounted on an insulating strip on one side. This latter is one connection to the driving coil, the other going to frame. The two terminals on top are two capacitor plates and should be connected together. The other plate is common to both and connects to frame.

The coils were wound on a former recently made available by a local manufacturer and known as type M04. It



A simple detector circuit which will enable the performance of the wobbulator to be checked on the C.R.O. Almost any germanium diode may be used.

fits a Noval socket hole, has internal iron dust cores, and the external can is 7-8in diameter by 1¼in long.

The actual coil data is given elsewhere in the article and the presence of the iron dust cores should obviate the need for any pruning. We used a single core only for each, but both may be used if necessary. The gauges of wire are not critical, but should be followed as closely as possible for purely physical reasons.

THE SWITCH

The switch gave us some food for thought. We started with a single deck, 2 x 5 type, but this was not very suitable physically. The two sections being on opposite sides of the shaft, it was inevitable that one set of leads to the coils had to be unduly long.

On top of this we ran into trouble with the 10.7 Mc coil. When disconnected from the various resonating capacitors it apparently had a natural resonance within the band swept by the 30 Mc coil. The result was a "hole" in the band at this frequency.

Our immediate reaction was to use a switch with a shorting plate on the rear of each wafer and which could be used to short out all unused coils in each position. This is standard procedure on commercial equipment and the switch is a standard type. However, it is not normally stocked by dealers and would need to be ordered specially in most cases.

At the time we commenced our experiments we were unable to obtain such a type, so we settled for a 2-deck, 2 x 5, wired as shown in the circuit. This is reasonably satisfactory, but we feel that the other arrangement is much to be preferred and intend to fit one as soon as possible. In particular, the shorting out of all unused coils, with the shortest posible connections, seems to help maintain a constant output from the range in use.

The two-deck switch also made possible a more logical wiring arrangement with very much shorter leads. Switching of the grid circuits occurs on the rear deck and of the cathode circuit on the front deck, using contacts in the same relative positions.

The two moving contacts are located as close as possible to the valve socket and the active contacts on the bottom of each deck used to switch the coils. The first set of contacts are left blank for the moment, the second set are used for the 30 Mc coil, the third for the 10.7, and the fourth for the 5.5. If a 600 Kc coil is used it will connect to the fifth set.

By locating the 30 Mc coil directly underneath the switch and the 10.7 immediately alongside it the highest frequency coils will be given the shortest leads. Any coils higher than 30 Mc may be self supporting types mounted directly on the first set of switch contacts.

MODIFICATIONS

It will be necessary to modify the switch slightly in order to give it the correct direction of rotation for this layout. Both decks will need to be turned around so that the contacts are toward the clicker plate and one of the stops on the clicker plate will have to be rendered inoperative.

A general idea of the layout can be obtained from the photographs and it will be seen that both the coils and the valves are accommodated under the chassis. This helps keep vital leads short even though a few non-critical leads have to be brought through the chassis to the valve socket. The valve is shielded, partly to help control radiation and partly to ensure that it is held firmly in the socket.

Most of the wiring is quite straightforward and not particularly critical. However, a worthwhile reduction in radiation can be achieved by attention to earthing points in the oscillator circuit proper. In this regard we make no special claims for this unit, since it is not intended as precise means of checking sensitivity. At the same time, the performance is quite good for such a simple design.

EARTH POINT

A common earth point is established at the valve socket and to it is returned the earth connections from the coils, as well as the .01 mfd by-passing the "X AMP" terminal. This by-pass also serves to prevent RF being radiated from this terminal.

The attenuator circuit also calls for special mention. The attenuator is mounted in a shield can made from either sheet copper or brass and a shielded cable is used to convey the signal to the output socket. The idea here is to prevent radiated energy from being picked up by any lead or component carrying attenuated signal. Otherwise, the effectiveness of the attenuator network will be impaired.

The attenuator box measures 2¼in x 1¼in x 7-8in. It should not be difficult

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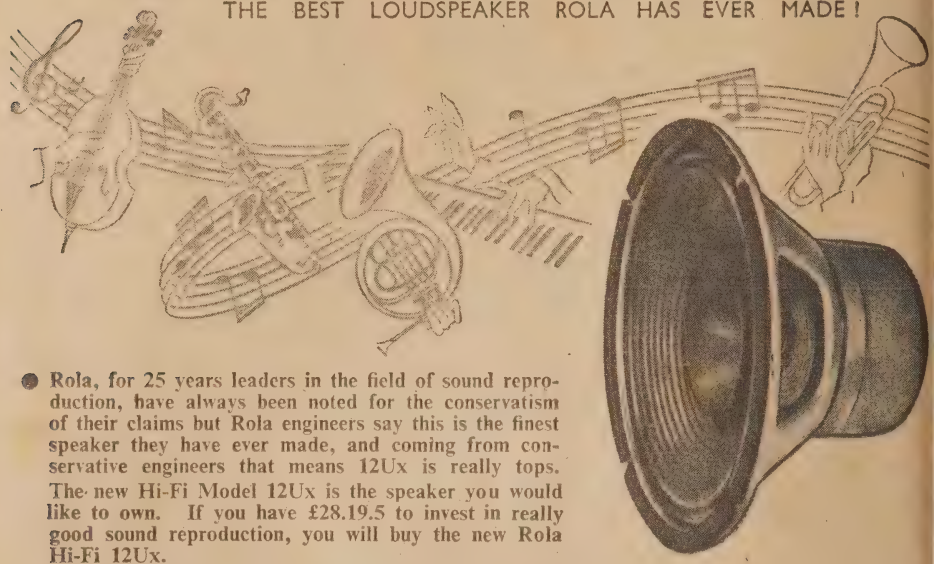

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● If you are interested in technicalities, here are the details:

Frequency response	40-14,000 c.p.s. flat ± 6 dB
(Usable response to 30 c.p.s. in the Rola recommended vented enclosure).	
Power handling capacity	20 watts
Intermodulation distortion : (F1/F2 ; 45/7,000 c.p.s. ; Ratio 1 : 1)	Less than 2% at 20 watts output
Voice coil impedance	15 ohms at 400 c.p.s.

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most home constructors to fabricate ething similar themselves, using it 20 or 22 gauge copper or brass. /e secured best attenuator control earthing the appropriate terminal of pot. inside the copper box. The lded cable is also earthed at this t, and, ideally, it would seem de- ile to avoid earthing the output cir- at any other point. In practice it not seem to make much difference, is probably not worth the compli- on.

ote particularly that the attenuator m, shield box, etc., should be nted before the coils are mounted. s not impossible to do this in the rse order, but it isn't easy.

ntil a permanent marker generator ted, a second shielded cable should onnected to the output socket and ght out through an unused hole in front panel. It is coupled to the ker generator through a 3 pf capaci-

he simple diode detector circuit pre- sly mentioned can be used for in- testing of the instrument, even as- ing that no TV or FM equipment is lable. The only addition will be nventional generator of some kind erve as a marker. As the marker rator is set to various frequencies marker pip will move along the . If the band is not covered exactly coil slugs should be adjusted accord- y. A sweep of 10 Mc should be ible at 30 Mc.

a subsequent article we will have e to say about using this generator, well as possibly describing a suit- marker generator.

EW MARINE RADAR

LIMITATION of conventional marine radar systems is that it is immediately apparent from a ship's display if an object is in fact ing or is stationary while, if moving, apparent speed may be deceptive ss careful observations are made.

new technique, called "true on", aims to eliminate these am- ities and present on the p.p.i. dis- a true, as distinct from a relative, re of movement in the immediate ity of the ship. It is achieved by ng to the existing equipment an liary unit known as a "Track- er".

to this is fed the ship's speed, either ually or automatically, and bearing mation from the gyro-compass. e data are converted into "east- " and "north-south" voltages which the origin of the p.p.i. scan in ac- ance with the ship's direction and d.

e effect is that of a bird's-eye of the situation, with land masses bouys stationary (instead of mov- and the observer's ship moving g its true course (instead of onary in the centre of the screen) all other objects travelling in their directions.

irection of movement is indicated, sual, by a luminous tail and, in tion, the "own" ship's course can indicated by a luminous heading (Wireless World, Dec., 1956.)

A NEW WIDE-BAND OSCILLOSCOPE

Continued from Page 63

Additional filtering could have been obtained by employing a filter choke with more inductance but since the current drain is large such a choke would be physically large. It is therefore more economical to provide the additional filtering required for the low level stages by means of resistors and capacitors and at the same time arrange for decoupling between the stages.

The filter choke is placed in the negative rather than the positive high tension lead as is conventional so that the negative bias required for the driver valve can be developed without the need for a resistor carrying the full high tension current. A high resistance divider circuit allows the bias supply to be filtered with a relatively small capacitor.

The concluding article will appear in the April issue where the vertical amplifier and its adjustment will be described in detail. We hope to include photographs from the screen of the CRT showing the effects of various maladjustments.

Also included in the article will be a table showing the normal voltages and currents throughout the circuit together with detailed information on components.

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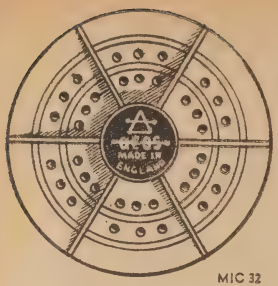

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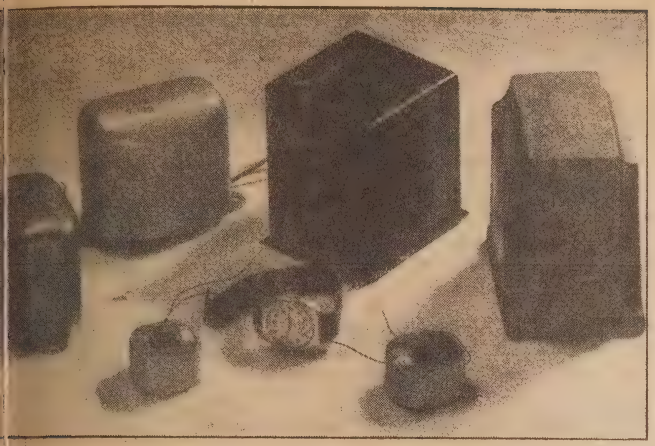
Magnetic fields. Coils with air and iron cores. Inductance, mutual induction. Direct and alternating current. Simple alternator. The sine wave and relevant terms. Inductive reactance, phase. Inductance in practice.



igure 7. A typical group of iron-cored transformers used in radio equipment and ompared in size with a watch. Windings as shown in the foreground are assembled n to iron cores, then sealed with pitch into metal or bakelite cans to protect them against damage, or corrosion due to moisture penetration.

Thus far our conception of an electric current has been confined to one of minute electrons migrating along the length of a conductor. It is now necessary to expand this mental picture to associate the movement of electrons with the generation of a magnetic field.

nductance and Alternating Current

T some time or other, we have all toyed with a horse-shoe magnet noted the mysterious attraction it for iron and steel.

/e know how a magnetised steel dle will align itself with the earth's netic* field—a phenomenon which he basis of the magnetic compass. following discussion involves this e rather mysterious force.

a pocket compass is held close a wire carrying heavy direct current, pointer is found to be deflected from normal due-north setting. Very iously, the wire must be surrounded a magnetic field which interacts h that of the earth and thus affects compass needle.

TURE OF FIELD

he exact nature of a magnetic field matter of much debate, but it is venient to think of it as so many s of force. The stronger the cur- , the stronger the magnetic field the more numerous the lines of e.

lternatively, we may say that the netic FLUX DENSITY is greater. direction in which the force operates is defined by identifying its poles in terms of north and south, which have the same magnetic sense as those of the earth.

In actual fact, the magnetic field surrounding a single conductor is not very great, but it becomes much more evident if the wire is wound up into the form of a coil. The magnetic field assumes the shape indicated in figure 1, the lines of force all passing through the centre and completing their circuit via the much greater space outside the coil.

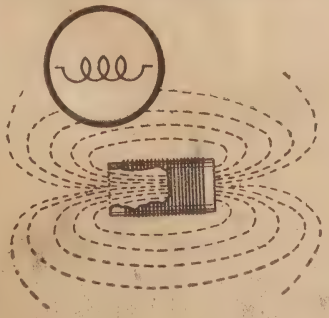


Figure 1. Showing how magnetic lines of force encircle a coil carrying current. In circle, the schematic symbol for a coil.

It is obvious enough that the magnetic concentration must be much greater within the coil than in any other region.

It is actually possible to state the direction of the lines of force surrounding a conductor or a coil, but there seems little point in the beginner committing this to memory just here. But note the schematic symbol for a coil, shown within the circle in figure 1.

Because of its magnetic properties, the inclusion of a CORE of iron within the coil can greatly increase the magnetic flux density for a given current through the coil.

To be a little more technical, we may say that the iron core has greater PERMEABILITY to the magnetic flux than air; the term "permeability" may be roughly defined as the flux multiplying property of a substance.

According to particular requirements, the iron core may be a simple iron rod, a bundle of iron wires, or a stack of iron strips. It may be of either round or rectangular cross-section, the latter being the most common in practice.

If the iron core is straight, as actually shown in figure 2, it assumes the characteristics of a bar magnet in the presence of a steady current through the coil.

In other words, it has a north and south pole, will attract iron objects and will align itself with the earth's magnetic field if there is no mechanical hindrance. (Note should be taken of the schematic symbols for air and iron-cored coils; in the latter case the core is shown either within or alongside the coil symbol, according to the whim of the circuit draughtsman.)

ELECTRO-MAGNETS

With a soft iron core, the magnetic effect is entirely dependent on the strength and the direction of the current through the coil. If the direction of the current is reversed, then the magnetic poles are interchanged. If the current is interrupted altogether, nothing but a slight residual magnetic effect remains.

Magnetic effects in a core due to current through the associated coil are very widely utilised in a variety

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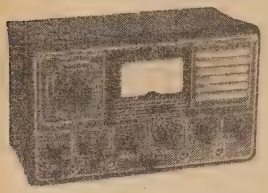
This month clients purchasing their Test Equipment for Cash, will have the opportuni of obtaining at no extra cost either of two wonderful test instruments.



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At the end of this month we will select two clients (disregarding value of purchase) and present to one a beautiful M.32 Service Multimeter, and to the other a Handy OM.2 Universal Ohm Meter. The selected clients will be advised by letter and published in the May edition of R & H. If either client all ready possesses these instruments the equivalent Cash amount will be given.

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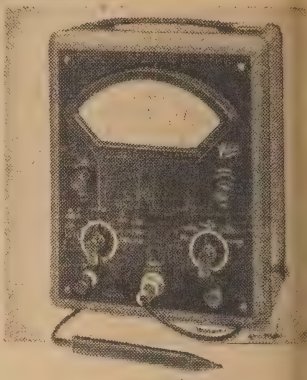

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Response .. .. 3,000-20,000 c/s	Flux .. .. 10,000 Gauss	Horn loaded .. .. .. 1,000 c/s Cut-off
Power Cap .. .. 10 watts	Dynamic Mass .. .. 0.008 gms	Dimensions .. .. 8½ x 5½ x 4½in
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dio apparatus, as we shall see in chapters.

wever, it is interesting to note that and certain alloys will retain their etic property even after the ener- current is switched off. In other s, they become permanent magnets, ere the iron core is continued d the side of the coil (shown dot- figure 2), the lines of force tend, ne most part, to follow the easier through the iron, and the magnetic in the free air surrounding the s correspondingly reduced.

a small gap is left in the IRON UIT, a very great magnetic con- ition is evident across it, and this s also utilised in numerous electro- anical devices.

NTS TO NOTE

e important points to grasp in all are (1) That a magnetic field is nt around a conductor carrying an ic current, and (2) That this mag- field can be controlled to serve ular purposes.

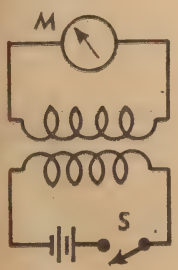
at can be regarded as step num- ne in our thinking. Now to go

ume that we have a battery and tch so arranged that we can direct ectric current at will through a Refer to figure 3 which, by the is the first wholly schematic draw- e have used.

en the switch is closed, the cur- builds up at a limited rate to an ate value determined largely by otential of the battery and the nce of the coil. With a very large ored coil, the building up of the nt is so gradual that it can be easily on an ordinary milliamp

effect cannot be duplicated with ely resistive circuit, where the cur- always comes immediately to its ate value.

y obviously, the coil must offer initial and temporary opposition



re 4. Changing currents through lower coil produce a corresponding .F. in the upper coil by mutual induction.

flow of current by a property distinct from the resistance of re.

cut a rather long story short, pposition is produced in the pro- of building up the magnetic field d the coil.

very action of building up the produces in every turn of the coil is known as a counter EMF—an d voltage, which is in opposition t from the battery. This counter is evident only while the mag-

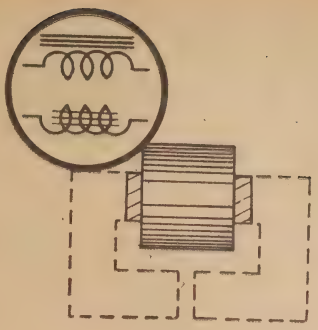


Figure 2. The inductance and magnetic properties of a coil are vitally affected by placing a soft iron core in around the coil. Note the symbol.

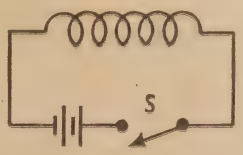


Figure 3. Schematic diagram showing how a current can be directed through a coil.

netic effect is in the process of building up, but it exercises a definite retarding effect on the action.

Once the current has reached its ultimate value—as determined by the battery voltage and the resistance of the coil—the magnetic field remains stationary and constant while ever the switch remains closed.

CHANGING FIELD

When the switch is opened, one might expect the EMF to disappear from across the terminals of the coil, but, for sheer stubbornness, the magnetic field must rival the classic mule.

The opening of the switch is the signal for the magnetic field to begin collapsing, which is to be expected, but, in the very process, a current is induced through the coil in the same direction as that originally initiated by the battery.

The induced current and the resultant EMF across the terminals of the coil may even cause a spark as the switch contacts begin to separate.

This magnetic effect is just as much a property of the coil as is the resistance.

It is defined as INDUCTANCE, and is measured in units known as HENRIES. Smaller units are the MILLIHENRY (equal to one-thousandth part of a henry), and MICROHENRIES (equal to a millionth part).

In the form of a general statement, it may be said that a coil possessing inductance—often referred to as an INDUCTOR—tends to oppose any change in the amount of direct current flowing through it.

If there is zero initial current, then the coil offers temporary opposition to the building up of a current in either direction. If there is an initial steady current, then the coil opposes any tendency for it to increase or diminish.

Read those last two paragraphs again. They are very important.

An interesting phenomenon can be demonstrated by mounting two coils in close proximity, so that the magnetic flux from one coil can intersect the turns of the other.

COUPLING OF COILS

Assume, as in figure 4, that one coil can be connected through a switch to a battery and that a sensitive indicating meter is connected across the terminals of the other coil.

On closing the switch, the meter pointer will be found to move slightly—say to the right—and then return to its normal position. If the switch is now opened, the pointer will show a slight movement to the left, demonstrating that, somehow or other, an EMF has been induced in the second coil.

The explanation is found in a general law that an EMF is always induced in a conductor, which is cut by moving lines of force, or, yet again, in a conductor which itself moves through a stationary magnetic field.

In the illustration of figure 4, the closing of switch "S" causes a magnetic field to build up around the lower coil, and, for a brief interval, lines of force are evident moving outwards from the coil. These moving lines cut through the turns of the upper coil and induce in it a voltage, which is made evident by the meter "M".

REVERSED ACTION

Once the magnetic field has become stationary, no further voltage is induced until such times that the circuit is broken and the field begins to collapse. The reverse movement of the lines of force then causes an induced EMF of opposite polarity.

A similar effect could be produced by passing a powerful bar magnet rapidly through the centre of the upper coil, or by sliding the coil to and fro over a stationary magnet.

While ever the two units remained in close proximity and there was movement of the coil relative to the magnetic poles, small voltages would be

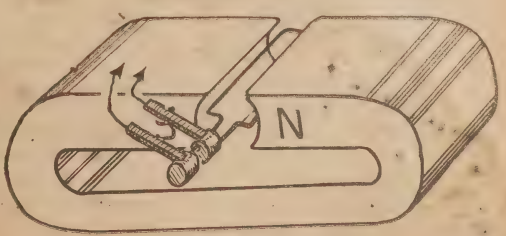


Figure 5. In its simplest form, an AC generator is a loop of wire revolving between the poles of a permanent magnet.

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Physical Size—¾" x ¾" x 2" high.

Mounting—23/32" square centre holes —⅝" apart.

Connections
P—Plate
B+—B+
F—Diode Cathode
G—Diode Anode
Pigtail—tertiary (audio)

IF Frequency—5.5 Mc/s

Inductance—(when tuned to 5.5 Mc/s)
Primary 16 uH
Secondary 8 uH

Q (In Can)
Primary 50
Secondary 70

Tuning Capacity
Primary 50 pf.
Secondary 100 pf.

REMARKS

A 5.5 Mc/s ratio detector transformer recommended for the sound section of intercarrier TV receivers may be used with either thermionic vacuum diodes or matched germanium diodes.

R. W. STEANE & CO. PTY. LTD., Auburn, Vic.

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"Q-PLUS" VIF7

5.5 Mc/s SOUND I.F. TRANSFORMER

5.5 Mc/s SOUND P.U. TRANSFORMER

5.5 Mc/s SOUND TRAP

Physical Size—¾" x ¾" x 2" high.

Mounting—23/32" square centre holes ⅝" apart.

Connections
F + G (being single tuned, can be connected in either way)

Frequency—5.5 Mc/s.

Inductance—(tuned to 5.5 Mc/s) 16 uH.

Q (In Can)—45.

Tuning Capacitor—50 pf.

REMARKS

A single tuned parallel resonate circuit recommended for use as either a Sound Pick up I.F., or 5.5 Mc/s Trap. May also be used as a single tuned 5.5 M/c IF transformer in TV circuitry under Australian standards.

R. W. STEANE & CO. PTY. LTD., Auburn, Vic.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

nt between the terminals of the

interesting condition arises if the "S" in figure 4 is opened and rapidly for a sustained period of Under these conditions, the mag- field around the two coils will be ained in continual movement, ng up one instant, collapsing the

obvious result will be a current gh the upper coil, which is con- ly changing its polarity. At one t, electrons will be moving from to left; next instant from left to and so on.

us assume, for agrument's sake, he two coils are quite large and tely coupled together, and that currents are caused to flow gh them; further, that the meter replaced by a small torch globe.

P FLICKERS

h time the switch is opened or , we can expect the induced cur- o cause a momentary glow in the so that it flickers off and on at id rate.

rying our assumption a little fur- let us step up the rate of opening losing the switch to such an extent the individual surges of current gh the lamp can no longer be ned, and it appears to glow ly.

then have a state of affairs where work is being done, not by a direct current from a battery, by an ever-changing current pro- by the relative movement of a uctor and a magnetic field.

electron movement which pro- the heat phenomena is no longer dy flow of electrons through a uctor, but an oscillatory or to-and- motion.

this simple way, then, we have introduced to ALTERNATING RENT, which is of tremendous rtance in the field of radio and icity.

ore pursuing the subject further, as well to be quite sure of the ence between DIRECT and ERNATING current.

ERNATING CURRENT

the first case, electron movement ays in the one direction. It may rge or small, or subject to con- s variation but, so long as it ns uni-directional, it is referred a direct current, or DC.

alternating current is one in the actual direction of electron ment is changing continually or riodic fashion.

e amplitude of the electron move may, of course, be large or small y particular instant, depending on ircumstances which initiate it.

alternating current cannot be uced directly by electro-chemical s, as in a battery, but is always ated by relative movement of a uctor and a magnetic field.

elementary type of AC generator the abbreviation) is illustrated in 5.

agine that a loop or wire is mount- that it can rotate between the of a permanent magnet; further, the two ends are brought out to ally insulated copper bobbins, make rubbing contact with a pair of metal or carbon rods known as BRUSHES.

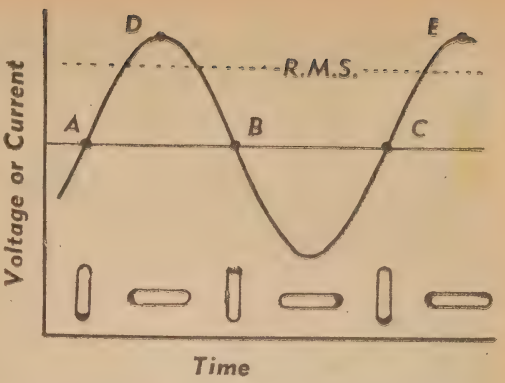

Figure 6. Illustrating a single sine wave and its characteristics. The position of the loop with respect to figure 5 is illustrated.

The magnetic field surrounding the loop of wire will be evident as lines of force joining opposite points on the faces of the two magnet poles.

When the loop commences to rotate, the movement relative to the lines of force will immediately initiate a flow of current through the wire.

Thus, as the left-hand side of the loop (as illustrated) moves upwards with respect to the South pole of the magnet, there will be a movement of electrons along the wire.

At the same instant, the other wire is moving downwards with respect to the North pole, so that the electron movement in this half is in the same general direction around the loop. As a result, an electron pressure—an EMF—becomes evident between the ends of the loop and is thence transferred to the two brushes.

At the instant when the plane of the loop is exactly parallel with the lines of force — that is, in the horizontal position — the loop cuts through the flux at the highest rate, so that the generated voltage or current reaches a peak value.

As the loop continues to rotate, the relative movement becomes less, so that the generated voltage is also reduced.

At the instant when the loop is in an exactly vertical plane, the wire is moving parallel to the lines of force and no current whatever is generated. Beyond this point, the loop again approaches the horizontal position, so that the voltage or EMF rises once more.

However, the electron movement through the loop is now found to be in the reverse direction; or we may choose to say that electrons are accumulated at the alternate brush. Whichever way we look at it, the simple result is that the voltage between the brushes is reversed in polarity.

Following the movement further, the current reaches a peak in this direction, then falls away to zero, immediately building up again with the original polarity. This process goes on just as long as the loop continues to rotate.

SIMPLE GRAPH

The matter can be made clearer with the aid of a simple graph.

Assume that we can observe the instantaneous value of voltage or current generated over a brief period of time, and that values of voltage (or current) are plotted against corresponding time intervals. On joining the plotted points we would have a curve similar to that shown in figure 6.

Assuming a zero reference line, the voltage would rise smoothly to a peak value, then diminish and pass through zero to an equal peak negative value; then back to zero again and so on, "ad lib". The plane of the loop, relating back to figure 5, is suggested by the small rectangles beneath the curve.

A practical AC generator is actually a far more elaborate device than figure 5 might lead one to believe, but the operating principles are the same.

In every country of the world, great AC generators are ceaselessly producing current for factories, homes, street lights and a dozen other purposes. Rotating machines of rather different type are employed to generate direct current for similar purposes, but AC has proved easier to handle and distribute on a large scale; just why does not concern us here.

Direct current finds its greatest ap-

(Continued on Page 105)

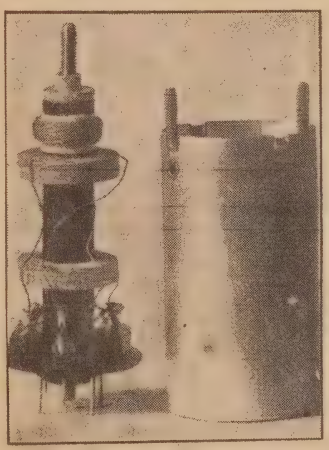

Figure 8. A typical radio type tuning coil, shown withdrawn from its aluminium can. This one has three separate windings and iron-dust slugs which are adjusted by means of the brass screws seen protruding from top and bottom of the assembly.

A COURSE IN TELEVISION

PART 19 — THE DC COMPONENT

In discussions pertaining to video detectors, v ideo amplifiers and gain control systems, fre quent reference will be found to AGC, the DC component and DC restoration. These term may be new to many readers and their significance is explained in the following article.

IN actual fact, the subjects are all deeply involved with the design of other sections of the receiver and it is not practical to examine them fully and independently. The purpose of this article is merely to discuss them in broad outline, leaving the details to be filled in later, as they arise.

By way of approach, it may be helpful to re-examine a conventional AM sound signal and then see how a television signal differs from it fundamentally. The influence on circuit requirements can then be shown.

The characteristics of an AM sound carrier are illustrated in figure 115.

AM CARRIER

Without modulation, as in diagram (a), the carrier has a certain steady value When ultimately amplified and applied to the detector in a receiver, it produces a definite and measureable change in voltage across the detector's output load.

The stronger the signal, the greater is the voltage developed by it.

If the carrier is amplitude modulated, it has the character shown in figure 115 (b), the carrier amplitude alternatively increasing and decreasing at an audio frequency rate, in sympathy with the sound content.

The important point to note is that the carrier amplitude excursions are strictly symmetrical in nature, each increase in amplitude being followed in cyclic fashion by a corresponding decrease.

As a result, the AVERAGE amplitude of the carrier, considered over a period of time, is the same as its unmodulated value.

This holds true, irrespective of whether the modulation is a simple sine wave pattern or a complex mixture of sine waves representing all the fundamentals and harmonics produced by typical program material.

In an ordinary diode detector the incoming signal produces a voltage of negative sense with respect to earth across the diode load. The voltage is constant for a steady unmodulated carrier, but varies about the steady value at an audio rate when the carrier is modulated.

Two distinct voltages are conventionally taken from the detector (or its allied circuits) in an AM sound receiver. One is applied to limit the gain of preceding amplifier stages (AVC); the other is the audio signal voltage to operate the audio system and loudspeaker.

The AVC voltage must be a DC potential, varying only with long-term changes in the strength of input signal. (These latter might result from signal fading effects or, more simply, when the receiver is tuned from one station to the next.) Modulation components must be kept out of the AVC line.

These requirements are met by d ing portion of the detector's o through a resistance-capacitance work having a long time constant – meg and .05mfd are common value

Such a network will not transmit components but delivers a potent the controlled valves which varies with the average strength (or ampli of the input signal.

Since the average amplitude of signal is not affected by modul neither is the AVC voltage. This most important point.

The audio component, which i quired for subsequent amplificatio represented purely by the cyclic V ATION in voltage across the det load. The fact that it is part and p of a varying DC potential is o significance to the audio amplifier.

In fact, the DC potential proc across the detector load is entirel

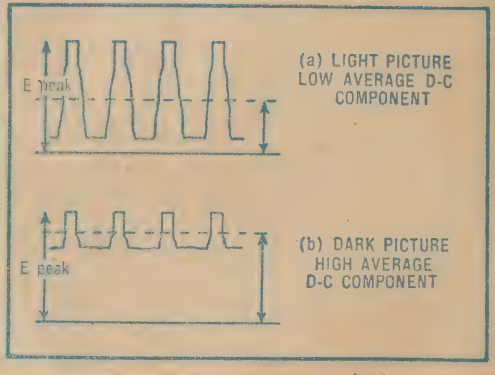

Figure 116: average amp of a tele carrier env and its DC across the det load (as illustr depends le on the conte the picture. complicates AGC and coupling ci

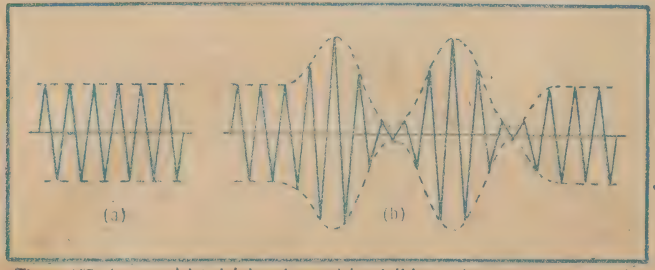

Figure 115: An unmodulated (a) and a modulated (b) sound carrier wave. Note that the modulation envelope is symmetrical about the mean, unmodulated value. Output from the detector would follow one or the other of the dotted outlines shown on either side of reference.

dundant and would only be an en rassment if applied to subsequent a stages.

In consequence, it is normal pra to insert a coupling capacitor bet the detector load circuit and the gr the following amplifier stage. This p on the varying or alternating compo which is the essential audio signal blocks the DC voltage or the "DC ponent", as it might equally wel called.

A television picture signal is fu mentally quite different in character a sound signal. It is not a cycl alternating phenomenon at all, b related purely to changes in light encountered along a scanning line.

The result can be regarded much appropriately as a DC potential v

arying rapidly in near-random
n.
n this "video" signal is applied to
rier for transmission the carrier
ave no natural or mean value and
odulation impressed upon it is not
etrical.
uming negative modulation, the
reaches peak amplitude only dur-
e brief intervals when synchronis-
gnals are being radiated.
between these pulses the carrier
ude may assume any instantaneous
between about 15 and 75 pc of
depending on the content of the
being scanned.
ht portions of a scene produce
um carrier amplitude. Thus, action
a background of snow or cloud
produce a relatively small average
amplitude between the pulse

H AVERAGE

versely, a night scene would pro-
large carrier amplitude between
and the average energy content of
gnal would be much increased.
en resolved by the detector in a
er, as in figure 116, these two
ions would produce quite different
e DC potentials across the load.
that this difference stems purely
the modulation content, not from
undamental variation in the peak
ude of the incoming signal.
m this fact stems an immediate
ather obvious difficulty with an
system. (Actually, AGC, auto-
gain control, is a more appropriate
for television receivers.)
he AGC is simply derived through
r from the detector load resistor
ions in picture content must affect
GC voltage and the gain of the
led stages.
s may produce changes in picture
st with variation in content and,
important, may produce enough
r in signal level to compromise
operation of synch. separation
s.
ew inexpensive receivers use simple
systems, but the more usual prac-
to "key" the AGC system so that
mples the incoming carrier only
the brief intervals when a line
is being radiated. Since the pulse
tude is a constant quantity, the
voltage derived from it is inde-
nt of picture content and the diffi-
s previously mentioned are avoided.

ER ARTICLE

subject of AGC systems will be
ned at greater length in a further
, but the foregoing will be sufficient
licate the relationship of AGC to
asic video waveform.
special nature of video signals
be considered also in connection
the amplifier and coupling circuits
en the video detector and picture

nsider the elementary circuit ar-
gment of figure 117, which infers
oupling between the diode detector
and the picture tube grid. (Such a
e has, in fact, been used in simple
as receivers.)
uming negative modulation and
um circuit adjustment, the picture
grid would be carried to cut off and
d when the carrier amplitude
ed about 75 pc of its peak value.
nversely, with the carrier strength
at 15 pc, corresponding to peak white, the tube screen would be fully illuminated. In between these limits the brightness of the trace would remain strictly proportional to the video carrier amplitude.

What has happened virtually is that the detector has recovered from the modulated carrier a DC potential similar to the original video signal and applied it directly to control picture brightness. The DC component has thus been preserved and usefully applied.

In practice it is not always convenient

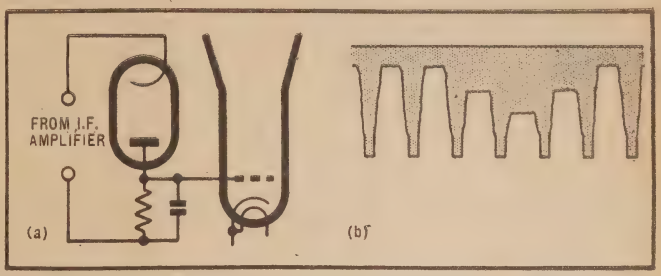

Figure 117: Direct coupling in the video system passes the DC as well the AC component, retaining both the average brightness and the contrast of the original image.

to have direct coupling between adjacent circuits and the designer may wish to isolate them for DC by the inclusion of a conventional coupling capacitor and following grid resistor, as in Figure 118.

The presence of these components, however, has a fundamental bearing on the operation of the circuit.

The coupling capacitor prevents the DC potential (or component) across the diode load from reaching the picture tube grid. It can only communicate to the grid the CHANGE in potential or

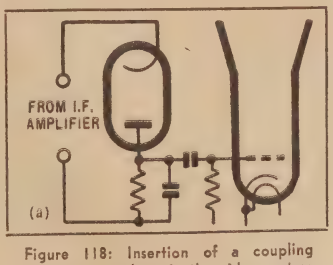

Figure 118: Insertion of a coupling capacitor anywhere in the video system blocks the original DC component This is frequently offset by the use of DC restoration.

what we might call the AC component.

As a result the grid is merely swung positive and negative with respect to the voltage imposed on it through the grid return resistor.

Under average conditions this leads to no special complications.

Standing bias on the picture tube is set to give some intermediate degree of screen illumination and the video signal superimposed on it produces the appropriate highlights or shadows.

It is under other-than-average conditions that complication arises.

If the picture should become predominantly light or predominantly dark for a period of time it will cause the average DC potential across the diode load to increase or decrease in proportion.

Because of the coupling capacitor this change in average DC potential cannot be communicated to the grid of the picture tube, to cause a corresponding general brightening or darkening of the image. The change in potential is lost, being evident only as a slight change in the charge across the coupling capacitor.

The grid still receives only the VARIATIONS in video level, which it continues to superimpose on the average screen illumination set by the "brightness" control.

If the original image were predominantly dark the screen might simply show it as a mid-grey image with reduced contrast. The black areas would show as dark grey and, under extreme conditions, the "blacker-than-black" signals may even fail to erase the spot during flyback periods.

By the same reasoning, very bright images would subside to mid-grey and the blackout pulses would be exaggerated.

Thus the use of AC coupling tends to mask deliberate changes in picture level and may also cause some wander in blackout level with picture content.

COMPLEX CIRCITS

While only a very simple case has been discussed precisely the same observations hold for more typical and complex circuits involving one or two video amplifier stages between the detector and picture tube. The use of a coupling capacitor at any point in the circuit must lose the DC component.

Just how important this is in practice is the subject of a good deal of current debate.

It is claimed that extreme changes in average picture brightness are not desirable and that, in practice, variations from average brightness are rare. That, as a result, AC coupling can be used without making any significant difference to the final picture.

Other designers contest this view and, if not able conveniently to maintain the original DC component, adopt a circuit arrangement which restores it artificially ahead of the picture tube grid. This is known as "DC restoration".

While, again, typical circuit practice must be discussed along with other sections of a receiver, the general concept of DC loss and DC restoration may be strengthened by considering a simple illustration.

Consider a train of square waves pro-

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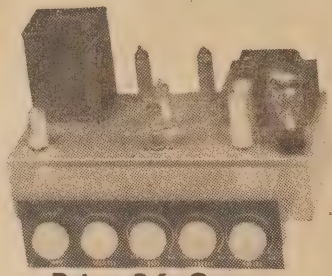

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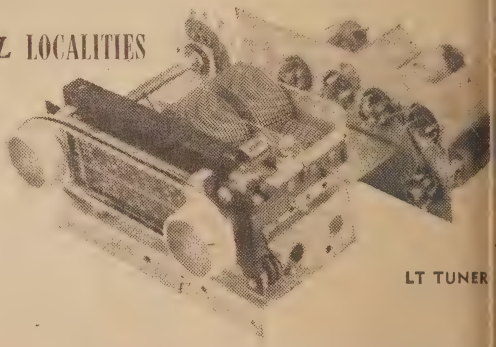

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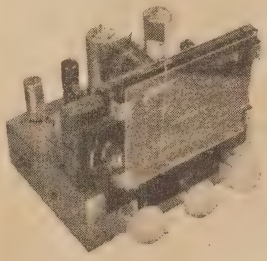

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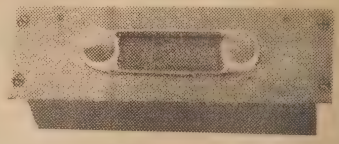

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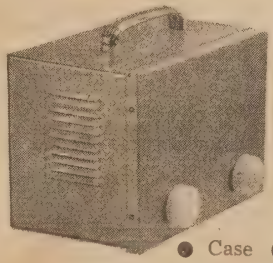

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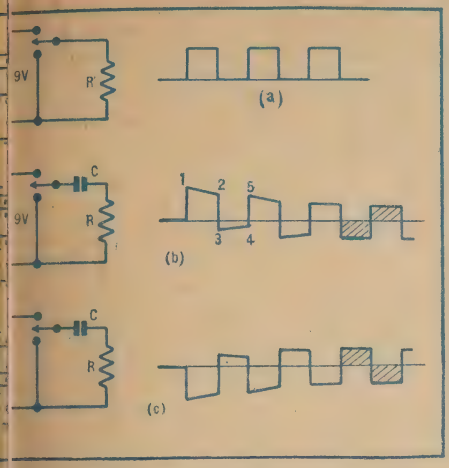

ge 119: Illustrating the effect of inserting a coupling cap r into a circuit having a DC component. The wave shape is preserved but the DC component is lost.

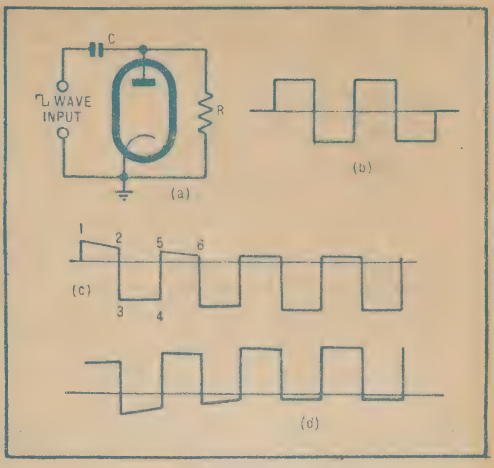

Figure 120· The action of a DC restorer (a), handling a wave-train (b), produces (c), which has a DC component. Reversing diode polarity produces the positive effect (d).

eby a battery and a rapidly moving c
figure 119 (a), we have a 9-volt e. a switch and a load resistor "R". s which the ultimate signal voltage emed to be built up.
t he instant the switch moves up d a potential of plus 9 volts appears the resistor. It disappears immedi- y he switch reverses, producing a wave train, as indicated.
let a coupling capacitor "C" be d in the circuit (figure 119b) and ole position changes.
the first closing of the contacts. l 9-volt pulse is applied through sistor R and we have the condition nted at point 1.

E OF VOLTAGE

e the switch contacts remain for a finite period, a discharge naturally tends to flow through sistor and it may, for example. the potential across the resistor 8 volts at point 2 on the graph. this juncture, the switch reverses nnection, suddenly reducing the al on the left-hand side of the or by 9 volts. This carries the across R to point 3, which is e with respect to earth.
further and reversed discharge follows to point 4 but it does not the original discharge before a positive-going pulse is received. ay carry the potential across the to say 8½ volts positive, which ges to 7½ volts before the return is applied.
process continues until the total l area below the reference line is to the total shaded area above the nce line. The number of cycles l to reach this state depends on the nts of the circuit but the condition ance will ultimately be arrived at. n this happens, the DC compon- s obviously been lost, even though ape of the wave may be closely ved.
s interesting to note that a wave ed by a negative-going pulse will ultimately resolve into the same form, as indicated by figure 119 (c).

Furthermore, while regular waveforms have been assumed for the sake of illustration, the same averaging process goes on with the highly irregular waveforms characterising a television signal.

When fed to a grid through a coupling capacitor, they tend to equalise around the grid's natural potential such that the total energy content of positive-going pulses balances that of the negative going pulses. The purpose of a DC restorer is to correct this condition and to realign the positive or negative peaks to some required reference level.

The simplest form of DC restorer is provided by the humble diode detector and its action is illustrated by figure 120

Imagine that a square wave is fed into the circuit of figure 120 (a). Keeping to the purely hypothetical values already suggested, the first positive-going pulse amounting to say 4½ volts would be applied through the capacitor C to the plate of the diode and the top end of resistor R.

Since the plate would then be positive, the diode would immediately commence to conduct, causing a flow of current through R and making the top of R much less positive than at the beginning of the pulse.

In other words, the diode would rapidly create a potential difference across C between the points 1 and 2 on the graph.

At point 2, the 9-volt negative going pulse would carry the potential at the top end of R to a point which might be 6 volts negative. Between points 3 and 4 there would be a slow counter discharge of capacitor C through resistor R only.

However, a further rapid discharge period occurs between points 5 and 6 with the diode conducting. After a few cycles, the top of the wave tends to level off at a potential close to the reference line, the bottom of the waveform being projected into the negative region.

STABLE CONDITION

The condition of stability is reached where the amount of charge through the diode on the positive half cycle is just equal to the charge lost through R during the rest period on the negative peaks.

Figure 120 (d) shows the reverse con-

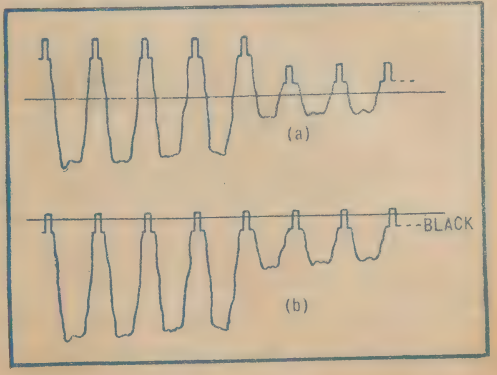

Figure 121: A video waveform, minus its DC component, may appear somewhat exaggerated as in diagram (a). When modified by a DC restorer, the synch. pulses and blanking level are aligned as per the original transmission and the signal acquires the form shown at (b).

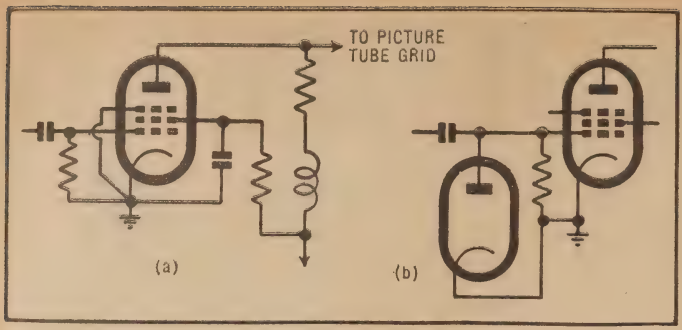

Figure 122: Operating without grid bias (diagram a) a final video amplifier stage can provide its own DC restoration. It behaves as if there were actually a diode (diagram b) wired between grid and earth. Though simple, the arrangement requires care in selecting operating conditions for the stage.

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dition, where the diode is connected the other way around in the circuit. Here the waveform is lifted in a positive direction so that it resembles the original waveform introduced in figure 119 (a).

Connected as in figure 120 (a), the diode is said to act as a "negative" DC restorer, while figure 120 (b) is a "positive" restorer.

Once again the general statement can be made that a restorer operates in the same fashion on irregular waveforms, tending to line up the positive or the negative peaks, according to its connection in the circuit.

Figure 121 (a) illustrates, with some exaggeration, the type of waveform which may be passed through a capacitively coupled video amplifier chain. The essential video information is present but the tendency for waveforms to balance around a reference voltage has altered the relative level of the synch. pulses.

Such a waveform might conceivably be fed to the cathode of a picture tube, the grid being bypassed to earth and used only to inject a bias voltage the "brightness" control.

EFFECT ON BEAM

In such a circuit, positive-going p as implied in figure 121 (a) woul off the beam current, while neg going voltages would produce highl

It is apparent that, if the cond sketched were to obtain, the pos going pulse peaks during part o time would not reach the blanking or black out the return trace.

To correct the condition would re the connection of a diode restore tween the cathode and some suitable age reference point. Operating a figure (120 (c), it would align the tive peaks and give the effect as cated in 121 (b).

Alternatively, if the detector were nected to give negative-going pulse p the signal would have to be fed t picture tube grid rather than to cathode, so that the negative would black-out the trace. The re diode would need to be connected circuit the other way round, alignin negative peaks as in figure 121(d).

FROM VIDEO STAGE

The same general remarks apply v the picture tube is fed capacitively a video amplifier stage rather than the detector.

The only obvious requirement is the polarity of the detector, the nu of video stages and the feed to the ture tube be manipulated to give a tive image on the screen. The re diode must be connected accordi always to align the pulse peaks.

In some commercial receivers, the video amplifier is DC coupled to picture tube and this makes it pos to provide DC restoration at the gr the amplifier. Having been establ at the grid, the relationship of the and DC components is maintained i plate circuit and carried through t picture tube.

In such circuits, the restorer would shunt the grid of the video a fier, the polarity being arranged again to give the required effect. not difficult by this means to alig pulse peaks to earth potential, cathode of the video amplifier bein to give any desired bias on this sta

SELF-RESTORATION

It is also interesting to record, in ing, that video stages can be operat such a way as to provide their DC restoration. See fig. 122 (a).

If the stage operates with zero bias, any positive-going pulses cause current to flow and charge the coupling capacitor. The action is cisely the same as illustrated in f 120, the grid behaving as a diode ment for positive-going signals.

As will be apparent from figure the circuit behaves in much the fashion as if a diode rectifier were ally wired between grid and earth.

The action is closely analagous, in to an ordinary AM grid leak dete

The particular arrangement prest of course, that the video amplifier operate under damaging condi danger of exceeding its dissipation ings. Further, that neither the amplifier nor the picture tube sh operate under damaging condi when no signal is being received.

(To be continued)

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OFF THE RECORD — NEWS & REVIEWS

Music has recently suffered greviously in the loss of men such as Solomon, Cantelli, Gieseking and Furtwangler. Once again we can be grate ful that they have left us such fine records. All had qualities of greatness, and none more so than the German conductor Wilhelm Furtwangler whose work was often controversial but always distinguished.

by John Moyle

ETHOVEN — Choral Symhony. Played by the Orchestra n Chorus of the 1951 Bayreuth estival with Elisabeth Schwarzo, Elisabeth Hongen, Hans Hopf n Otto Edelman, conducted by Vilhelm Furtwangler. HMV OALP 2 7.

album will be judged not for its the nature of the recording or formance of the players, but for emergent quality the credit for must go primarily to the con-

is a sincerity, a loftiness, a pas- purpose unequalled by any other, hich even Toscanini has not d.

doubt these things were largely duct of the occasion. The records ade at an actual performance at th in 1951, and have all the hall- of it. For that it can be taken technically, but its gain is far than its loss.

NCERT PERFORMANCE

acoustics, placement of the choir on had to be accepted as they and it sounds exactly what it is — y in an opera house.

the technicians have done their well, and this description is not lemnation.

pared with the best studio efforts, s a flatness in soft passages, and wness in the loud, reminscent of studio 8H, in which Toscanini with many of his early efforts. orrections of the mixing panel om time to time produced marked ces in balance throughout the mance.

result, it often sounds dead where r recording hall would have bound sic together. Quiet moments just quiet, they are often remote. ind and brass frequently sound gh they were directed elsewhere the microphone.

oday's standards it is not the best, gh most of it is extremely good.

T POWER

n beginning to end it is filled with nd nervous power. Furtwangler it irresistably. The second move- s a good example of this, although may not like its free and sudden changes.

they will just as surely recognise ll the nobility and strength of ven.

choral movement suffers most in e—the choir, soloists and orchestra achieve really good combination trast.

the singing is fine. There are no ng sopranos, and the quartet of ished names outshines all com- in. What a maddening business it must be to get this part of it just right.

Had it been possible to achieve perfection acoustically, this would have been the best of all Ninths. As it is, I would prefer to avoid comparisons, and give it a place all its own as a record of a magnificent performance, fine enough to rise completely justified through many difficulties.

I hope it is never removed from the lists. Furtwangler never had a more eloquent testimony.

MOZART—Recital of Sixteen songs sung by Elizabeth Schwarzkopf accompanied by Walter Gieseking. Columbia 330CX 1321.

In general, these songs are quite different from the soprano arias we are used to hearing in Mozart operas.

Most of them were written in the last few years of his life, and have more than a touch of German lieder about them.

If there is a worthwhile criticism to offer it is that both Schwarzkopf and Gieseking invest them with too much weight. This fine soprano is a good enough artist to sing almost anything convincingly, but sometimes I could have wished for a lighter touch. Not all the songs benefit from the complete maturity she commands.

Gieseking plays like a giant restrained —he is a collaborator rather than an accompanist, one who seems afraid of his part, which ideally lies somewhere between the two.

The piano has a woolly sound, and the record generally, although very clean and forward, hasn't a particularly bright tone.

For all that, this is a really fine disc and a most unusual one. There are no surface troubles, which adds to the effectiveness of an artist who has few equals in her field.

SLEEPING BEAUTY MERITS TOP AWARD

TCHAIKOWSKY.—The Sleeping Beauty Ballet (complete with original score) played by the Minneapolis Symphony Orchestra conducted by Antal Dorati. Mercury MG50061-3 in presentation album.

This is the third and in many ways the best of Mercury's three magnificent albums of Tchaikowsky's ballets. Musically it is beautiful, technically it is superb and in presentation it is equal to anything here or overseas.

The Nutcracker and Swan Lake were successive triumphs which created a sensation when they were first released.

They provided me with some of the best record listening I had ever enjoyed. They were issued as luxury presentation items in beautiful albums with profuse illustrations and notes.

But they have nothing on this elegant silver production with its tasteful colored drawings by Oliver Messel.

To go through a performance like this, nearly three hours in length, and attempt to place a value on individual episodes would be a hopeless and rather futile task.

As with the other two ballets it has a fairy story, the one dealing with the princess who fell into a deep sleep when her finger was pricked with a needle to fulfil the curse of a wicked old witch, only to be awakened by the fairy prince, married, and presumably lived happily ever after.

The story is made the vehicle for a sequence of dances and scenes of bewildering variety and beauty.

Although the recording might well have been made about the same time as the first two ballets it is, if anything, the best of the three.

It is my idea of perfect recording material. The music will appeal to everybody, mixing the romantic, the sentimental, the brilliant, the humorous, the not-too-tragic and infectious exhilaration which Tchaikowsky does so well.

His richly colored orchestration is a gift for an orchestra like this, and the Mercury touch fits it like a glove. I cannot remember a recording in which there has been more impressive sound, cleaner or better-defined brass, more delicate blending of every orchestral color and sheer, undistorted weight.

GOOD FOR DEMONSTRATION

On its technical merits I have more than once used it for demonstration (don't we all?) when I wanted to show off my equipment to friends.

But for all its vivid realism there is no distress in it. The strings do not shriek, the brass does not oppress, the magnificently hard tympani does not rattle, there is no sign of groove echo, the highs and lows are in near perfect balance.

These are the kind of records which can only inspire admiration and gratitude, which can be dipped into at will and whose appeal does not flag.

Well worth the money, I give them my highest award.

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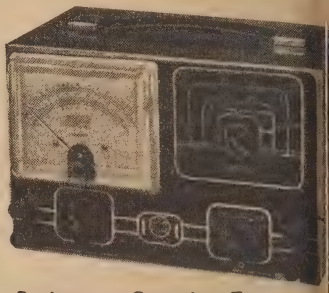

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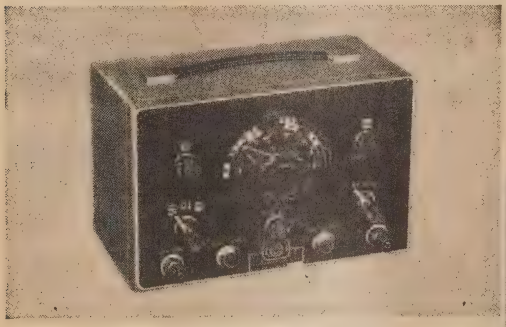

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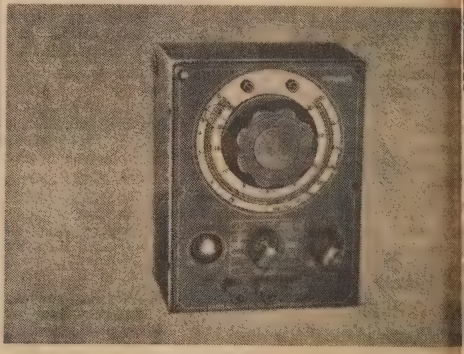

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EETHOVEN—String quartets 1 in F Major, No. 2 in G or, No. 3 in D Major, No. 4 Minor, Opus 18. Played by Hungarian String Quartet. Col- a 330CX 1168-1172.

e are four of the six quartets make up the Opus 18. There is doubt about the exact order of ition, but they were published in nd probably composed during the s three years.

sense, Beethoven served his ap- sh in them. They owe more dn and Mozart than do the later although neither of his great ssors could have supplied the un- able ingredient which was Beet- himself.

e time he had produced the final s, little remained of the spirit here. In his last years, Beethoven quartet far more profoundly than other time, and in a manner not ted except perhaps in the piano of the same period.

ISTENTLY GOOD

on occasions do we hear any ze t. his later manner. The slow ent of No. 2 goes through some motions, but the real intent is not Between them there is a vast ce in experience and emotional ment. Of this set, No. 4 is per- he most forward looking.

The Hungarian players are consistently good. Their approach is entirely masculine and vital. Throughout they favor a fast pace which occasionally interferes with the sensitivity of a phrase — the first movement of the No. 3 is invigorating, but could have been more gently touched in its lighter moments.

The leader is always deft and clean, and none of his team has any need to fear the consequences of the tempo, or of any technical difficulties. No one could fail to be delighted with their precision and complete command.

The second record, containing Nos. 3 and 4, I would select as the better of the two, mainly because I think they are the best quartets. I thoroughly recommend them to any suffering from a lamentable suspicion of all chamber music.

The recordings were made two or three years ago, and are not as good as I had hoped. They have rather a dull sound which is improved I think by playing them on the Decca curve, although extra bass does not appear to find much to work on.

I would not discount them merely on this score, nor can it outweigh their many other virtues.

I can only hope that we hear more chamber music by these and other players — for some reason record companies don't find public response to this kind of music encouraging enough to issue very many.

LTER BRINGS PLEASURE AND PROFIT

IE BIRTH OF A PERFORM- E—Rehearsal and finished re- ng of Mozart's Symphony No. K425) ("Linz"), played by the bia Symphony Orchestra, con- d by Bruno Walter. Coronet 512-513.

e has never been a release quite s one, although after hearing it will wonder why not.

as released in Australia some ago, but it is still receiving in various parts of the world it for the first time.

side of four contains a full per- ce of the Linz symphony. The ree are given o an almost com- hearsal by Bruno Walter and an ra of players assembled for the as the Columbia Symphony ra.

ARRANGED

claimed that the rehearsal ses- ere in no way arranged for the , and that neither conductor nor knew their efforts were being re-

well believe this, for it would be ble to have achieved such a con- atmosphere in any other way. ou have never heard such a re- before, you will be completely at the care Walter has taken with rasing and note values of the nance.

will appreciate, too, the hours of with the score which are neces- for a conductor to absorb its musi- ntion completely, long before he a baton and attempts to coalesce orts of a band of specialist ns.

in fact, a pointed answer to the question—Is a conductor strictly necessary?

Every one of the players is obviously of first quality, each, no doubt, with an idea about how a certain passage should go. Each has played this music hundreds of times.

But the conductor brings them together on common ground, sorts out differences and oversights, gives shape and precision to rough edges, hesitancy and poor unison.

And if he is a man of Walter's experience and scholarship they will learn, as we do, a great many new things about the music.

This is, in fact, one of the most valuable points about these discs, for had it been merely an account of an orchestra being taught the music, or being tutored for poor playing, it would have been intolerable.

As it is, Walter proceeds to the task of producing a fine performance in an atmosphere of friendly firmness through which we learn a great deal about him as a man and a musician.

The performance, when it comes, is somewhat disarming, for we have heard it grow, and it seems impertinence to disagree with it.

Not that there is any great need for this, as it is a very fine one. I thought it sounded a little careful, a little too watchful of the passages upon which much time had been spent. But this impression may have been purely in my own mind.

For the serious listener to orchestral m[illegible] I cannot recommend this release too highly, both for its content and its presentation. Not the least fascinating thing about the latter are the pictures of Bruno Walter in action, shot probably without his knowledge with a miniature camera.

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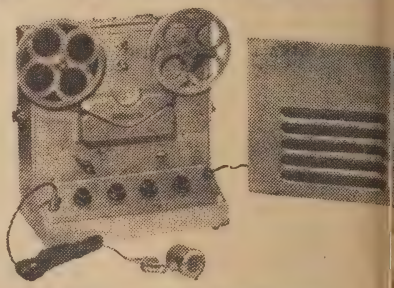

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the Aldeburgh Festival Choir
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ir, Ralph Downes (organ),
ducted by the composer. Decca
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e legendary tales of the life of
Nicolas, the patron saint of travel-
eamen and children, are the sub-
a brilliant and characteristic can-
y Britten, who shares the honors
ith Peter Pears.
pite its modern idiom and modes,
true cantata, with a community
about it that makes the audience
pation in two hymns completely
riate.
same spirit is carried out in the
two choirs, one of girls and one
ys, which are neither better nor
than we would expect from any
under better-than-average training.
authenticity, and the obviously
king efforts of all concerned is one
record's greatest charms.

OY ITS VITALITY

el, therefore, that it is better to
and appreciate the originality and
vitality in the music rather than
too critical of certain aspects
performance.
licker and more polished atmos-
would have robbed it of much

cantata was performed here in
under the auspices of the Sydney
sity Music Department a year
ago, so there will be many who
elcome its release.
er Pears sounds very much like
in Herbert at times, and carries the
ell; his voice seems to have lost
pleasant edge evident in records
t years. It doesn't ring quite as
as it did, but I cannot think of
her English tenor who could do as

ca have done a good job of what
have been a difficult task with so
performers.

RUCKNER—Symphony No. 4
flat major, played by the Vienna
harmonic Orchestra, conducted
Hans Knappertsbusch. Decca
A 5065-6.
the Philharmonia Orchestra,
ducted by Lovro Matacic. Col-
ia 330CX 1274-5.

is a long work, although the
t of Bruckner's symphonies. In
ginal form it was 100 bars longer,
few years later it was revised
e version used here.
vever, anyone who contemplates
er knows he is in for a long ses-
o there is no need to labor the

of his symphonies are played in
lia, but the "Romantic" is prob-
he most popular and the most
recorded.
ruckner initiate may have trouble
sering a comprehending course
h the seemingly interminable pro-
of repeats, wind-ups, progressions
ng-persistent musical argument.
as I have remarked on other
ns, there is nothing really diffi-
out Bruckner, only plenty of him.
n you will begin to recognise your
arks, and I hope enjoy much bean-
nd impressive music. The sym-

phony is virtually built on a simple, three-note phrase announced by the horns in the first few bars, and repeated with elaborations and variations in all four movements to form a rhythmic basis for the entire structure.

Orchestral demands are huge, but the Vienna players give a magnificent response. The horn passages, so vital to the music, are particularly good and have been cleverly positioned to give a distant, woodland quality heard with fine effect in the opening passages.

The conductor has not pursued the heavy climaxes to their full limit, and I thought this lack of violence in keeping with the prevailing mood. The success with which he has built and preserved this romantic restraint, without weakening the weightier moments, helps to preserve a continuity hard to maintain over such a long course.

I liked it better each time I played it.

Of the recording I have no criticism. It has excellent balance, good dynamic and frequency range, and a low surface noise. The sound is a little remote, but I like it that way.

The Siegfried Idyll is equally well played, and comes as a great contrast with Bruckner, to whom Wagner was a god-like figure and completes the four sides.

The Philharmonia's performance under Matacic is another fine effort, very different in atmosphere from that of Knappertsbusch.

It is much more vigorous, its romanticism is much more highly colored, and it has little of the mystic quality of its contemporary.

GREATER CONTRASTS

Dynamics are more fully exploited, nowhere with greater contrast than in the big climaxes, which come through with considerable force.

The difference in subtlety is illustrated in the opening horn passage to which I have already referred. Here it is played just as well, but its significance is vastly different.

It is probably a matter of taste which point of view you will like best.

The Columbia has much the heavier recording. Its sound is rounder, more impressive and more forward. I don't think I would trade it for the Decca as a steady diet, but I'd be much happier in avoiding a choice at all. It's rather a pity that a prospective purchaser will be forced to do so, for both versions are excellent, as might be expected from perhaps the two finest orchestras in Europe.

BRAHMS — Double Concerto for Violin and Cello, Opus 102. Variations on a Theme by Haydn, Opus 56A. Tragic Overture, Opus 81. Played by Isaac Stern (violin), Leonard Rose (cello) and the Philharmonic Symphony Orchestra of New York, conducted by Bruno Walter. Coronet KLC 522.

We think of a concerto today as a work for orchestra and single soloist, but it had its origins in the days when groups of instruments performed this office.

A number of great composers have produced double and triple concertos, but they have never been popular on the concert platform.

This is probably because it is hard to get good soloists together — and pay

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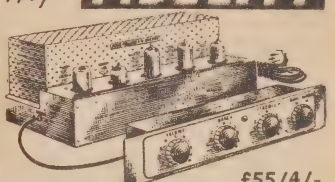

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nor do star names always take
) sharing the limelight.
such works were written for
ance by friends of the composer,
ome event at which they were
r.
is liked this concerto, although
he liberty of not classifying it
best. But it has some fine
, and no one should quarrel
performers Coronet have col-
play it.
vo instruments create an unusual
at times overloaded and deficient
tion. It is often hard to detect
happened to them, particularly
e-stopped passages. The cello
sink back into the orchestra,
as rather a heavy-handed sound

ld have thought it easier to get
balance during a recording than
cert.
and Rose play manfully, but
they don't quite manage to
consistent focus.
the Variations and the Tragic
are treated with care rather
ality. Walter is meticulous in
er where such treatment is in

good deal of Brahms for the

**)STAKOVICH. — Symphony
0 in E Minor. Played by the
rmonia Orchestra conducted
em Kurtz. HMV OALP 1322.**

is a tremendous amount of
to be done with this symphony
there is so much in it to hear
ardly digest. It's pretty concen-
stening, too, for the composer
all interested in entertaining us
ng our minds.
nd music are serious things to
witch, and always have been,
e his first symphony.
er his comments about his own
to be taken seriously or not is
atical. For instance, he insists
first movement of his latest work
ially lyrical.
nostly we recognise a potent
oly, a man brooding over the
and the past with a mind shot
with emotions and ideas, weav-
shouting restlessly and disturb-
h many conflicting voices, intro-
to a degree.
ntil the last movement is there
f from the Russian-like humor-
spect, not unlike a present-day
vsky occupied with the complex-
odern thought and idiom.
ularly in the first movement the
t is in characteristically long
t weave and wail in contrapuntal

quite moving in a strange way—
musical experience in it that is
ng and powerful. There is sin-
oo, the product of economical
-woven musical thought.
eart and soul of the thing is in
; first movement. The tough,
ed scherzo that follows is no
rast, and the quieter third move-
es little more than ruminate in
but less poignant manner.
is brightness and greater anima-
the finale—less weight to the
too great a tension to completely
from the memory of what has
ore.
ght the performance superb.
technical points are annoying.
d movement cuts out before the
rd has finished, as though the
tape had come to an end, and there are a couple of groove echoes where the micrograding has clamped down too suddenly after a loud finish. Inspection through a glass confirms that it is not due to plain overcutting. A noticeable example occurs after the very last bar.

Otherwise the sound is extremely good —vivid and powerful when required, smooth and well balanced on many sustained passages.

It's one of the most potent releases of recent months.

RACHMANINOFF — Piano Concerto No. 2 in C minor Opus 18. Played by Eugene Istomin and the Philadelphia Orchestra conducted by Eugene Ormandy. Coronet KLC530.

The recording which made this concerto famous is the original Rachmaninoff-Philadelphia performance of nearly 30 years ago. Since then the work has become almost a tradition in the orchestra's distinguished history.

Only those to whom these old 78's were a new thing can know the impression it left on all those who heard it for the first time. The music has never been shaped and moulded as it was by Rachmaninoff himself.

This version at times fits quite closely to the original mould — more nearly perhaps than any other yet released.

Many passages one might imagine were modelled on the composer's own performance, but it is neither as mature nor as consistent. Particularly in the second movement, the young pianist allows his brilliant exuberance to break the smooth flow of sound which is handled very well indeed by all.

CONTRAST IN MOOD

This centre section provides a contrast in mood, but it is purely complementary, and should not break out into an interruption. To his credit, Istomin offends less severely than many other pianists of his school.

He tends, too, to play through the tone of the piano as, for instance, in the opening bars, spoiled by a jangle of sound which should not have been allowed to develop.

Otherwise this could be the best Rachmaninoff so far. The authentic Philadelphia treatment is often heard, the resonant cellos, the clean fortissimos, the appealing woodwind, and the crashing cymbals.

Recording level is high, but nowhere is the strain too much, not even in the exuberant finale which is particularly well done.

The Preludes are pure Philadelphia, and are elaborately orchestrated by Calliet who has performed a similar service for this orchestra in many other items, including some controversial Bach.

A good disc, destined, I think, for deserved popularity.

LALO — Symphonie Espagnole in D minor Opus 21. MAX BRUCH—Violin Concerto in G minor Opus 26. Played by Isaac Stern and the Philadelphia Orchestra conducted by Eugene Ormandy. Coronet KLC 544.

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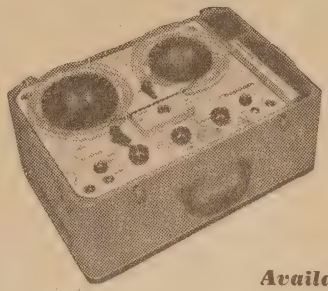

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COLLINS RADIO, 179 FLINDERS LANE, MELBOURNE C1.

/hich rivals that of Oistrakh, nd the result particularly satis-

red with Campoli's record me time ago his version is ressive to hear. It has a sharp- and a greater certainty. Cam- on a smaller scale with greater nd romantic appeal. He seems ach the music more seriously n, who loses no opportunity to is virtuosity, for which he has scope, in brilliant work of the ade.

Bruch there is again a compari- Campoli, and this is one of his rmances. Again it is on a scale han Stern's, whose recording is ward and more firmly handled. ly, too, he is the master. Cam- no real counter to this flashing

re is the contrast between the obvious than in the slow move- rn's cool, strong tone is one mpoli's more intimate warmth her. Your own preference may le here, for in its own way each nce is first rate.

the impression of unanimity he players on both sides of this e forward violin is not out of f it is the dominant voice, and s frequent sense of hurry, it ct with some very beautiful

rface is good, and the RIAA ems right.

BRUCH — Violin Con- No. 1 in G minor Opus 26. by Wolfgang Schneiderhan Bamberg Symphony Orches- ducted by Ferdinand Leitner. 17028 LPE.

general reckoning, this record where between Campoli and

elerhan is comparatively detached proach as compared with the o. He does not resemble either mantic touch. He sounds very ore scholarly and he works

und of the record is not as as its competitors, nor is the as impressive. It is a quieter e subdued performance, free works, but it has a serenity not m either Stern or Campoli. lance of violin and orchestra l he best of the three, and al- has a lesser impact, it is no formance.

ain criticism of Schneiderhan's characteristically thin tone in r registers and his free use of which might almost be called

a single 10in disc, so that you ave to take another work with extra money.

face is impeccable.

RHMS—Symphony No. 4 in ior Opus 98, played by the Symphony Orchestra con- by Paul Paray. Mercury 5057.

care some fine versions of this ov. The Toscanini recording good today, although the per- is, and both an early one by Decca, and later on by Walter ps, have fine qualities. the latter are warmer, more and gentler Brahms than that

ecording is noticeably brighter and harder. He does not lack a suitably romantic atmosphere, but it hasn't at all the European touch.

Nor is he averse to highlighting instruments here and there to color the sound in almost a Stokowski manner. (One noticeable example concerns the cellos in their statement of the broad, flowing theme in the second movement. Paray lifts them up almost to solo stature.)

It is a brisk, bright performance, neatly and cleanly outlined.

I thought the sound needed some taming. I used the EMI setting to reduce the top, and even a further touch of top cut may not be amiss.

Paray frequently goes for spectacular effects you may not entirely appreciate. That biting blare of brass at the opening of the last movement is not favored by other conductors. It is dramatic, but it does not altogether line up with the mood of the movement.

The recording is appreciably brighter and more immediate than its contemporaries, and played at good volume in a largish room it is impressive.

Surface is good, if not quite top grade, but the cutting amplitude and dynamic range are so great we can afford to neglect it.

I would class it as one of the best we have.

MENDELSSOHN—Violin Concerto in E minor Opus 64. MOZART—Violin Concerto No. 4 in D major K218. Played by David Oistrakh and the Philadelphia Orchestra conducted by Eugene Ormandy. Coronet KLC529.

The Mozart is a contemporary of a Philips recording by Grimiaux, and to my ears, it does not equal it for sensitivity and charm.

Oistrakh's sensitivity is a high-powered variety. There is a majestic air about his tone which can become quite awesome at times. But Grimiaux sings much more sweetly and warmly—he touches the heart while Oistrakh remains remotely magnificent.

The new recording is extremely forceful. In many respects the general nature of the sound is quite similar, but Coronet's is of higher amplitude and on the whole more impressive.

These two are the best D majors available.

Campoli is the danger in the Mendelssohn, but only with qualifications.

I feel that Oistrakh makes too much of the concerto which can safely be allowed to go its own sweet way.

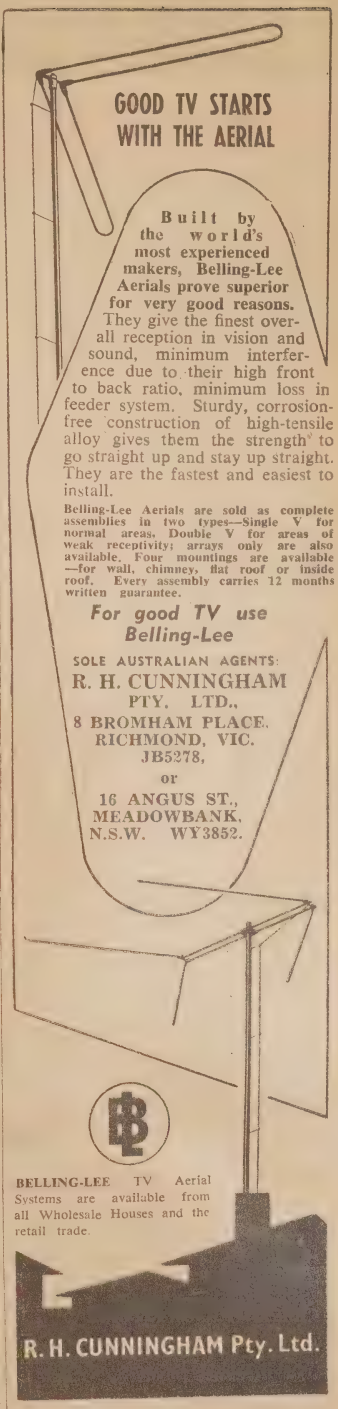
This Campoli allows it to do, and although not in Oistrakh's class purely as a fiddler, he achieves a sincerity and simplicity which Oistrakh does not.

But it would be foolish to deny the authority and strength of Oistrakh, his certain intonation and his magnificent tone which never falters.

These things alone make it a memorable disc.

The violin is extremely forward until you get used to it. Noticeable, too is the use of the mixing controls to build up the cadenzas and solo passages. If you listen carefully, you can hear what seems to be a traffic rumble behind the third movement cadenza which, incidentally, has an unusual treatment.

The orchestra is good, but as usual it is Oistrakh who takes the honors.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SHORT-WAVE NOTES BY ART CUSHEN

SWEDISH PROGRAMME NOW WEEKLY

- Fourteen transmissions each weekend are the new schedule for the popular session from Stockholm.

SWEDEN Calling DXers, the popular session which has been broadcast from Stockholm for many years, has reverted from a monthly to a weekly transmission. The programme is compiled by Arne Skoog, and will now be broadcast 14 times on Sunday-Monday. The session replaces the normal English news sessions in these transmissions, and this new schedule is the biggest airing for any of the world's dx programmes. The complete schedule is as follows,

SUNDAY

9.00 pm 17840 Kc to South America and United Kingdom.
10.00 pm 9620 Far East.
11.30 pm 17840 Eastern North America.

MONDAY

12.30 am 11705 South Asia.
2.00 am 15155 Western North America.
3.15 am 9535 Middle East.
4.15 am 11705 Africa.
6.00 am 6095 Europe.
9.00 am 9620 Far East.
10.00 am 1178 Europe.
11.15 am 9620 Eastern North America.
12.45 pm 9535 South Asia.
2.00 pm 9535 Middle East.
4.30 pm 15155 Africa.

The session will be on the air for 5 to 6 minutes, and listeners who wish to send items about the stations they are hearing should send them to Arne Skoog, DX Editor, Radio Sweden, Stockholm 7, Sweden.

★ ★ ★

Tests from Tangiers

TWO tests have been reported from the Tangiers stations, and these have been logged by English listener Sydney Pearce. The Voice of Tangiers has been using the 9810 Kc. channel from 7.30 to 8.00 am with the broadcast directed to Scandinavia. Reports were requested to The Voice of Tangiers, British Post Office, Box 219, Tangiers. Radio Tangiers has been testing a new aerial with the broadcasts in Danish and English and the channel was that of 9660 Kc. transmission time being 5.00 am to after 6.15 am. Reports to this station should be sent to Radio Tangiers, 33 Goya St., Tangiers, Morocco.

★ ★ ★

Publication preview

THE WORLD AT A TWIRL is the catchy name for a book written solely for shortwave listeners—quite a rare type of publication these days.

This book will be of great interest to all shortwave listeners. It is profusely illustrated with photos of many of the leading DX listeners throughout the world, as well as personalities of broadcasting stations. A comprehensive log of stations is included together with an extensive time chart.

The articles include one on the history of many of the better known radio stations as well as the activities of many dx listeners.

The World at a Twirl, published by Kenneth R. Boord, 948 Stewartstown Road, Morgantown W. Va., USA. Price is two dollars 50 cents.

Sarawak concludes test

THE transmission of the evening program from Radio Sarawak which we reported last issue, has been concluded on that band, reports the Publicity Officer of the station to West Australian listener, Cyril Anderson. The station stated that the normal night time channel is 5052 Kc. and daytime broadcasts are on 6062 Kc. The test transmission heard was a trial run on 6062 kc. during the evening but this has been abandoned because of interference in Sarawak from adjacent stations.

Radio Sarawak uses vertical incidence 12 element vertical arrays which provide a high concentration of energy in Sarawak, so that regular reception of this station in this area is unlikely. But the station is most interested to learn about listeners enjoying regular reception of the broadcasts.

The Sarawak station on 5052 Kc. can be generally tuned from 11 pm to midnight when the English hour is presented, with the relay of news from the BBC at 11 pm, after midnight the programme is in Chinese to sign off at 12.45 am.

Notes from Listeners should be sent to Arthur Cushen, 212 Earn Street, Invercargill, NZ. All times are Eastern Australian.

Test from Delhi

ALL India Radio at Delhi is testing as we go to Press, at 8.00 am for listeners in Australia. Due to the poor reception of the service from Delhi, in the normal 8 pm service, trial is being made with the reception of the broadcasts in the mornings here.

The first three days of the transmission test were carried on 21570, 17720 and 15105 Kc. the latter two signals being very strongly received. Tests are planned on 17720, 11710, 15105 Kc for three further days.

Reports on the comparison of strength from the 8.00-9.00 pm normal service, and the test 7.00-8.00 am are being requested by the station addressed to the Chief, Engineer External Services, All India Radio, Box 500, New Delhi.

★ ★ ★

Station PZH5, Surinam

THE AVROS station PZH5, operating on 4765 Kc., has acknowledged a report of July 1955 with a book containing information about the station and its programs. The publication which is in Dutch is not a verification, so a further report has been submitted. The station operates 7.40 pm-11.40 am, local time in Perambanco being 6.00 pm-10.00 pm. We were fortunate in 1940 in verifying this country when they were operating on 15400 Kc.

Shortwave Broadcasts from the Cameroons

A NEWCOMER to the shortwave broadcasting field is this African territory, and a recent issue of Radio Call gives the complete picture of the broadcasting organisations.

A letter from Mr. Louis Joos, Director of Radio Diffusion du Cameroun, has forwarded this information to an Adelaide listener, concerning his stations, which accompanied a verification card about broadcasts from Radio Yaounde. Mr. Joos reveals that Radio Yaounde began broadcasting in July 1955 with a one kilowatt transmitter loaned by the Postal Administration. Frequencies employed were 9270 Kc.

On the same day the semi-private station of Douala using 1 Kw. in the 49 metre band, was taken into the network of the Overseas Broadcasting Service. Linked with Yaounde, the two stations formed an administrative unit, the Radio Diffusion du Cameroun. Some months later, new transmitters were installed.

Yaounde now has a 4 Kw. transmitter on 4975 Kc. and Douala 1 Kw. equipment on the 49 metre band. Both stations inaugurated three daily tranmissions on October 1, 1956. These are from 4.00-5.00 pm; 9.15-10.30 pm; and 3.00-7.00 am. The last transmission is the best for reception in this area. Plans for a new station in the Moslem north of the Cameroons are well underway. Incidentally both Douala and Yaounde are located in the Christian south. The new station is at present under construction at Garoua, the administrative capital of Northern Cameroons. It will be equipped for two years with a one kilowatt transmitter at present on order. The final installation of 4 Kw. equipment is planned. It is hoped that the station will be placed in service on March 1, 1957.

FLASHES FROM EVERYWHERE

BRAZZAVILLE in its attempt to p transmission to the Pacific area has ch 19 metre frequency from 15420 Kc. Kc. and is operating here from 3.00 pm pm. This reception is reported fro America, and listeners are hearing the s gram also carried on the 11975 Kc. broadcast in English at 3.15 pm, from th African station located in French Africa.

This new frequency clears the ch 15420 Kc which is used by the BBC in mission to this area from 4.00 to 6.00

NORTH BORNEO station Radio Saba mitting from Jesselton, with 5000 watts callsign VQA54 assigned for the oper 7180 Kc. This channel is heard w news at 9 pm. Sabah has also the frequencies which can be used: 497 7240, 9660, and 9740 Kc.

FRENCH SOMALILAND with the t at Djubouti, is operating on 4785 Kc. callsign, TXZ30, reports World Radi book. The station is on the revised of 7.00-8.15 pm (Sundays 5.30-7.00 p 1.00-5.15 am; Saturdays 11.00 pm-1.00

SIERRA LEONA has extended the b from the Freetown station, and the b are now carried on 3316, 9630 Kc. opera 8.00 am. The broadcasts are of a loc 7.00-8.00 am, and occasionally 4.30-

BELGIAN CONGO station Radio Cor at Leopoldville, is now broadcasting on station OTM1, which replaces the transmitter and OTM2 on 9380 Kc. stations now close at 7.05 am.

COSTA RICIAN station TIGG, R celsior, San Jose, is scheduled weekda 3.00 pm and Sundays 10.00 pm to 11.3 Monday. The station uses 1060 on 6075 Kc.

SOUTHERN RHODESIA which oper Federal Broadcasting Service in Salisb dicates the stations transmit as follow 10.00 pm, 1.00-6.30 am daily, using th ing frequencies and callsigns, ZEAF ZEAJ 6018 and ZEA 9505 Kc.

WINDWARD ISLAND BROADC SERVICE at Grenada has made a m quency change from the 16 to the band. This 250 watt transmitter wa heard last month, but the new freq 11705 Kc. should also be heard. Th signs on at 8.00 am. The 5 Kw t still operates on 3395 Kc.

ALBANIA operates Radio Shkorda Kc. from 3.30 am, reports World Rad book. The station opens with news slan and does not relay the Tirana at this hour.

MEXICAN station XEQQ operating on has been reported from North Amer news in Spanish at 11 am, 2.45, 2 pm. The station has also programs 9500Kc, but this is the first reported rec XEQQ for some time, the station was one several years ago before VI H9.

AFRICAN signals are reported by Cyr son of West Australia, and as the m March is generally regarded as the be for signals from this area, this informa other details on stations in this continen be used as a basis for listening, recent best at dawn in the 41, 49, 60 and bands.

The Salisbury station in Southern has been logged on 7275 Kc. at 3.00 good signals in the west. ELWA in Liberia, the West African Mission ra been heard on the frequency of 493 7.00 am.

CENTRAL AMERICAN signals are by a North American listener to Radio who mentions Radio Jamaica at Kins 4950 as opening at 9.30 pm. Others areas of the West Indies are Radio on 4965 Kc. with a news broadcast i at 8.45 pm, this is a possible logging New Zealand leaves the nearby 6080 K nel at this hour; Radio Commerce at Prince Haiti, has been heard in E 8.30-9.00 am, using the 6091 and 9 channels, the latter being the only o would be loggable here.

RADIO DAKAR is using a 49 M reports Radio Australia when the sta been heard at 5 pm on 6045 Kc. the s gram being heard on 4890 Kc. French cast at 5.00 pm and African music at

IE HAM BANDS WITH BILL MOORE

ough most amateurs spend many hours each week talking on the air, it is only at Ham- or conventions that they have the opportunity to meet country amateurs personally. They also see old friends who are not so active in amateur radio these days.

nth Annual Hamfest of the NSW of the WIA was held over the ay weekend in January, with a overseas and country amateurs in

session was the normal monthly Friday evening when 80 members ture presented at Science House by McDonald, of Philips Electrical is subject "Transistors". were interested to learn of the ds of manufacture and uses of additions to the radio component

id session was held on Saturday nd evening at the Ocean View ighton-le-Sands, when a series of demonstrations were presented. ened with an excellent display of TV receivers home built by Ed 2EN, and Vince Cahill, VK2VC. ob was receiving the VK2/VK3 eld match and it was difficult to he lecture with so much interest he demonstration.

ed by Vince, explained the con- the 21in set, giving the following anufacture: 4 hours on ironmongery; wire and 3 hours to line. aid of test equipment the job of was demonstrated. Ed stated the had proved no more difficult to a first quality communications re- ded that suitable test equipment for lining-up. It was their seventh venture.

l lecture covered "Simple Standing for Co-axial Lines" and was rry Goodman, VK2ZAG. He had eries of large-size circuits to clarify oints covered. A practical demon- their use was presented. Harry K2AIZ, displayed a tripler stage to 15 Mc band.

tea break Berry Beresford, VK2ABB. number of suggestions on amateur of modern TV tubes, a series of ere shown; these were provided by d shown by Dave Duff, VK2EO, g arrangements were in the capable hands of Mrs. VK2YC, VK2EO, VK2EN and VK2DY.

The usual give-away session was then conducted and much useful equipment distributed.

The highlight of the weekend was the outstanding attendance at the VK2WI-Dural QTH on the Sunday.

The exact number of persons present was not recorded, but at one stage 83 cars were counted in the station ground.

The VK2WI Sunday broadcast was transmitted and old-timer Chas. Maclurcan, VK2CM, who has presented the VK2WI transmitter to the WIA, spoke on the session. A considerable amount of disposal gear was handed out and some sold after very spirited bidding, the proceeds in aid of the VK2WI building fund. Disposal gear was provided by the committee, Harry Solomons, VK2AJZ; Allan Williams, VK2FH, and Alec Dan, VK2ABU. The last two named were the auctioneers.

Members attending were very impressed at the progress on the VK2WI building, which is practically complete, except for internal painting and the installation of equipment.

Dural will prove very popular as a weekend picnicking spot for amateurs and their families, with plenty of parking space, water, and other facilities.

Equipment was provided for prizes by a number of commercial firms, including Mullard Australia Pty. Ltd., Ducon Condenser Ltd., Lawrence and Hanson, Bambach Pty. Ltd., William McLellan and Co. Pty. Ltd., George Brown and Co., United Radio Distributors, United Capacitor Co., Philips Electrical Industries, O. T. Lempriere and Co. Pty. Ltd.

Overseas amateurs attending included VS2DC and ZL3FP, country amateurs present were VK2AJO, VK2BQ, VK2AVJ, VK2XT, VK2FP, VK2PZ, VK2ALU, VK2DY, VK2ON, VK2RU, VK2ZDM, VK2ACS, VK2ADZ, VK2PN, VK2ZS, VK2PL, VK2ASZ.

The success of the convention depended on the concerted effort of a number of amateurs, mainly the council, who comprise President Jim Corbin, VK2YC, Harry Pickett, VK2AHP; Ed Hulme, VK2EN; Vince Cahill, VK2VC; Barry White, VK2AAB, and Barry Goodman, VK2ZAG.

VHF activities

THE section's Autumn 144 Mc Field Day will take place on March 31. Details of the event will be given over VK2WI and in the monthly bulletin.

The 144 Mc hidden transmitter search for February, run by the NSW VHF section, was again a victory for Bob Winch, VK2OA. The event was a progressive affair with the winner of each run (over 8 to 10 miles) becoming the fox for the next session.

As the transmitter was located on each occasion, all the parties were called up before the new fox set out to hide himself.

Bob won three runs and was the fox on three occasions, the ultimate on the day. Eric Dickson, VK2AFM, won two runs, and John Miller, VK2ANF, one. It was a new type of event and proved very popular.

It would appear that the VHF section of the NSW Division will shortly incorporate amateur TV as one of their interests. Many amateurs are busy building TV sets from elaborate 17 and 21in jobs down to simple 5in tube arrangements.

Undoubtedly the TV transmission side will soon be followed by a number of amateurs who hold the special TV permits.

★ ★ ★

London TV conference

In the UK 140 amateur TV enthusiasts attended the 1956 Amateur Television Convention held in London.

The outstanding feature was an "Outside Broadcasting Unit", consisting of an old London taxi (bought for £5), complete with 2 Kw petrol generator, a TV camera tripod and 70 CM Vee Beam mounted on the roof. The camera control unit, monitor and camera were in the passenger compartment. First-class pictures were transmitted back to the convention hall. G3KKD/T was responsible for the installation.

The reception of the BBC TV sound channel on 41 Mcs by WIA member, Norman Burton, of Sydney, over a prolonged period has been discussed at length on the VHF bands. First heard in October, the feat has received much publicity in the daily Press.

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Over the Atlantic

IN December the Atlantic was again bridged on 50 Mcs, the first occasion during the current sunspot maxima and the consequent F2 layer DX working. Reception of signals was first recorded when Dud Charman, G6CJ, heard Ed Tilton, W1HDQ, RST 569 in November. Unfortunately, 28 Mcs was not open at the time and a cross-band contact did not eventuate.

E12W, of Dublin, made the first contacts in December, working with W1FOS, W1HOY, W1HDQ, W2UTH, and W8CMS, all on 50 Mc telephony, signals peaking at S9 at various times. E12W operated on 28 Mc.

Similar cross-band contacts were made by a number of G stations, including G5BD, G6DH. W stations on 50 Mcs were also heard calling a number of Continental stations. It is hoped that the MUF will rise to 70 Mcs later this year and so permit cross-band 50 to 70 Mcs working.

Incidentally, to overcome antenna problems associated with cross-band working with a single beam, G4ZU has produced his VHF Minibeam (you will remember his 28, 21 and 14 Mc Minibeam). It is described in the December issue of the RSGB Bulletin.

It is designed to cover the 4, 5 and 6-metre bands with a single direct co-axial feed and operates by the aid of stub switching. Overall measurements of the array are 2ft shorter than the conventional 50 Mc Yagi array.

With such an array available a number of inter-Continental VHF records should be possible. DX workings at these frequencies have been difficult with French and Russian stations on 72-72.8 Mcs, UK stations 70.2 to 70.4 Mcs, Australian and New Zealand stations 56 to 60 Mcs, and American, Asian and African stations on 50 to 54 Mcs. All the above frequencies are effectively covered by the Minibeam.

The beam will again be manufactured commercially, and is the subject of patent rights, but no objections will be raised to construction by individual amateurs.

B Emergency Work — New Rules for Contest

S3 Radio Amateur Emergency Net comprises over 1000 members and the d concession allowing the hand- e Cross messages in emergency and ated tests has definitely stimulated

ent conference of net officials with officers, the activities and limitations operation were defined, maps show- decentral of amateur stations were a demonstration of mobile opera- Red Cross officials were enthusiastic ibilities of amateur communications. t also impressed by the willingness o co-operate in their public-spirited

★ ★ ★

mpt to attract youngsters to the , the RSGB this year will occupy e "Schoolboys' Own" Exhibition. e amateur station in operation ature and simple equipment which t by schoolboys will be shown. will be made to create interest in and short-wave listening.

of exhibition provides an excellent interest prospective recruits in WIA Divisions have co-operated exhibitions; it is a method of h keeping in mind.

★ ★ ★

contest committee has been active he society's contests to make them , as was seen with the recent The rules for their National be conducted in June, have been odified.

permitted has been raised to 10 and 28 Mc bands are now in- peration is permitted from 1.8 to serial number exchange has been conform with IARU recommen-

Some limitations on operations and equipment are still included and examples are listed below:—

The number of aerials to be erected at each station is limited to four and they must not be constructed of a greater size wire than 14 SWG (rules out elaborate Yagi arrays), however, the masts may be used as verticals. Aerials must not be higher than 45ft. Three transmitters and one receiver is the limit but reserve equipment can be held.

Scoring is arranged on a sliding scale with extra points for contacts with portable stations. National Field Days are extremely popular in the UK and 200 stations participated in the event last year.

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The Radio Society of Great Britain has decided to publish a new edition of their Amateur Radio Handbook which has been out of print for some years. Originally published just before World War II, the handbook became very popular among signals and radar personnel during the war years.

NEWS of amateur activity from interstate sources is solicited to make these notes of greater interest to all Australian amateurs. ● Due publicity will be given to amateur events, photographs too of amateur outings, shacks, etc., for publication would be appreciated. ● Information etc., could be forwarded to the Editor Radio Television and Hobbies, Box 2728c GPO, Sydney, or direct to W. M. Moore VK2HZ, "Dobijowi", Pitt St., Springwood, NSW.

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Sockets, 10/- each.

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7A6	5/- ea.	6K7G	12/6 ea.
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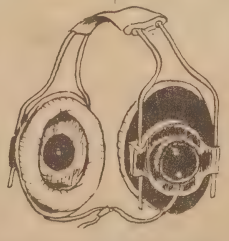

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These units will develop a constant 1000 cycles n 4.5 volts applied. Ideal for morse code sets—no and facility for High or Low Impedance Earphones t (size 3¼" x 2⅛ x 1 5/16"). **Price 50/-.**

MORSE CODE KEYS.
Bendix Type MT11B .. 10/6
(Fitted with cord and plug) 17/6
Standard Army Serv type .. .. (Fitted with cord a plug) .. ..

teur interference small

t radio interference figures released six-monthly period in 1956 by the Office clearly show that radio amaonly a very small portion of the ints received.

he period 226 reports of amateur to Band 1 Television were recorded, ee cases of interference to Band III

e, the most serious form of BC was attributed to radiation from he base circuits, with 3115 cases of TVI.

ured with amateur figures the fol- the chief causes of interference Television—sewing machines (5727 ers (4767), vacuum cleaners (3767), 3147), power lines (2607), and other vices.

six months 56,000 cases of TVI cases of BCI were recorded by

★ ★ ★

iprocal licences

he Stresa IARU Conference the has been endeavoring to arrange ost Office that foreign amateurs UK should be isued with a short- on a reciprocal basis.

has examined the societies' pro- two others submitted by foreign is to see whether reciprocal ar- ould be entered into with those dministrations, whereby an amateur taking a holiday, could apply for amateur licence in the country in hes to operate.

ll after consideration have been modify the requirement that an an amateur licence of any sort itish subject.

arrangements for amateur radio between many countries in Europe. , and, of course, between British

★ ★ ★

Vorld traveller

O BLACK, VK2QZ, is again away of his tropical trips and this jour- him to Malaya, India, and many countries in Africa. He hopes to from some of these spots. Bob embered for his previous trips to his YJ QSL with an anophele sking, and his VK9 contacts.

ill be travelling without his radio this occasion and will be oper- various amateur stations in the visits. Bob is journeying by air gage weight was limited.

overs across Asia to Aden, then on to Nigeria, Belgian Congo, back coast of Africa to Kenya, Tangan- anda. Bob is making further in- his specialised field of tropical

ave for Australia from Johannes- If you hear any CQ VK's from as in March and April, Bob may in the key, anxious to contact his stations.

957 Beru Contest

TION conditions experienced on ands during the 1957 BERU were the number of contacts to be 28 Mc band was limited.

ntests of this type, with restricted operation it was extremely dif- out the competitors from the signals on 14 Mcs. On the 21 here CW operation is not so competitors appeared and at ority of stations on the band were he contest.

stralian competitors were scoring VK2GW and VK9XK, and should ove the 200 contact mark.

C.C.P. CLASS

VI.A., Victorian Division, f Class will commence on 29th April, 1957. Morse ulations are held on Thurs- Theory on Monday even- n 8 to 10 p.m. Persons of being enrolled should cate with the Secretary Victorian Division, 191 treet, Melbourne (Phone from 10 a.m. to 4 p.m.), lass Manager, on either of e above evenings.

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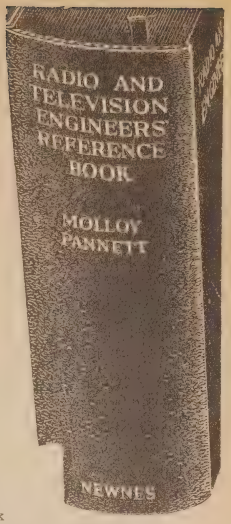

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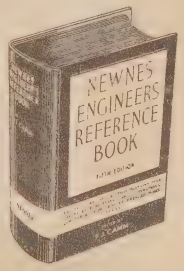

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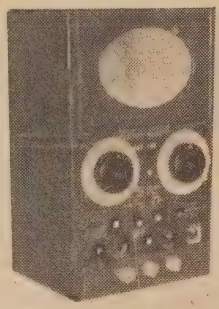

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Panel Mounting. 2½ in. Sweep
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American 12V. Input.
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12 volt operation
9 megs. 10 watts output
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6 valve 10 watt 6V. **£20/15/-**
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MULLARD 5/10.

£34/15/0

Complete with Jensen twin cone speaker, Ferguson O.P. transformer, 301 & U.L. taps.

MULLARD 5/20 AS ABOVE

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Tuner & separate control box with mike, pre-amplifier.

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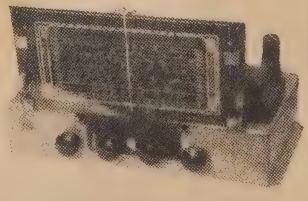

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(Continued from Page 83)

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it as well at this stage, to
certain common terms which
with alternating current.
pattern such as is shown in
eferred to as a SINE WAVE,
has a definite relationship to
of an angle — something
all who have studied trigo-

OF SINE WAVE

not interrupt your train of
enlarging on the matter,
ber that a SINE WAVE
lternating current or voltage
st form. If irregular peaks,
mps appear in a wave pat-
no longer a pure sine wave.
imum value attained by the
current in either direction
is its PEAK value. How-
eak value is a purely instan-
and, at all other times, the
voltage is of lesser magni-

a value, therefore, can scarce-
ded as a fair indication of
of the current to produce
ffects, such as lighting the
a lamp or raising to red
ment of a house-hold radia-

ty of an alternating current
l work, in this sense of the
pressed by what is known
S value of the current (or

MS (or root-mean-square)
definite mathematical basis
ine wave, it is equal to .707
peak value; in other words,
under three-quarters of the
of the wave.

AUES

therwise stated, figures of
or current are always
refer to the RMS value.
he application of an altern-
ial of 6.0 volts RMS to the
a lamp will cause it to glow
the same brilliance as 6.0
as from an electric battery
rator.

ess the magnitude of an
voltage or current, we use
uantities as for DC: Amps,
microamps; volts, millivolts,

ssary to bear in mind, how-
e stated RMS quantity sum-
heating or energy value of
ing wave over a period of
value of the current or volt-
particular instant may be
ess than this, depending on
cular portion of the wave
pen to pick.

again to figure 6, the space
nts A and C is known as
e CYCLE. From point D to
one cycle, since they are
valent points on the curve
ut one complete rotation of
alternator.
ame reasoning, from A to B, and from B to C is exactly one half cycle, representing half the time interval of a complete cycle and a half rotation of the alternator loop. From A to D and from D to B are each one quarter-cycle.

Of vital importance is the FREQUENCY of an alternating current or voltage, which is the number of complete cycles occurring in one second of time.

In the simple alternator of figure 5, the frequency is obviously dependent on the speed with which the loop is rotated, or the number of revolutions per second.

The frequency of the alternating current power mains is not standardised throughout the world but it is usually either 40, 50 or 60 cycles per second, depending on the particular country or area in question.

In most cases, the adopted frequency is maintained very accurately by the electricity supply authorities, who maintain a constant check against observatory time signals. The widely used synchronous clocks depend for their accuracy on the frequency of the power mains.

VISTA OF FREQUENCY

The vista of frequency is almost unlimited, as we shall see later in our discussions of sound waves and radio broadcasting. So while you are busy forming a mental picture of an alternating wave, leave room for an enormous range of frequencies and for the peculiar ways the higher frequency voltages are liable to behave.

The final step in this chapter is to correlate the earlier discussion on inductance and our more recent discovery of alternating currents.

Remember that a coil of wire exhibits an initial and temporary opposition to the passage of an electric current but, once this current is maintained for a brief period of time, the coil offers just the same opposition to any tendency for the current to increase or decrease. The property is referred to as the inductance of the coil.

It is, therefore, not difficult to imagine just how an inductance reacts to the passage of an alternating current, which is continuously changing in value and direction.

Obviously, the coil is going to offer a continuous opposition, quite distinct from that due to the DC resistance of the wire.

REACTANCE

Furthermore, since the opposition involves the building up and collapsing of a magnetic field, it is fairly obvious that the opposition will increase in proportion to the speed with which the current tries to build and collapse the field; that is, with rising frequency.

The opposition offered by a coil (ie, by an inductance) to the passage of current is referred to as its REACTANCE. Like resistance, it is measured in ohms, but, as we have seen, its value for a given coil is directly related to the frequency of the current or voltage concerned.

Thus, a given coil may have a reactance of 1000 ohms at one frequency and 2000 ohms at another frequency. In this respect it differs from pure DC resistance which is a fixed and definite quantity for DC or for AC of any frequency.

Inductive reactance differs from pure resistance in another vital aspect in the opposition it offers to the flow of an electric current.

When a voltage is applied across a resistance, the flow of current commences instantaneously, and ceases immediately the voltage is removed.

Thus, when the voltage applied is alternating, the current reaches its peak value at the same instant as the voltage peak, and goes through the same variation in value.

CURRENT "LAGS"

In the case of an inductance, the current builds up more gradually, taking a definite time to reach a peak value.

Thus, when the applied voltage is alternating, the current does not reach its peak value until a measurable time after the voltage peak. It goes through the same cycle of alterations, but the peak and minimum values are attained somewhat later then the corresponding voltage variations.

The current is said to be OUT-OF-PHASE with the voltage, LAGGING behind it by a definite amount. Alternatively, it may be said that the voltage LEADS the current.

With a purely inductive circuit, the difference in phase amounts to a complete quarter-cycle.

Inductance plays a vital role in all radio circuits. The simplest cases are coils having from half a dozen to a hundred turns of wire wound in a single layer on a cardboard, bakelite or wooden spool.

In other coils, the turns are wound one over the other in a compact "pie". Sometimes a powdered iron core is included within the spool or former to increase the efficiency of the coil.

More elaborate forms of inductance are the iron-cored FILTER CHOKES and TRANSFORMERS, which are essentially an elaboration of figure 2. The part all these components play in a radio circuit will become apparent as these studies progress.

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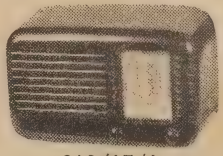

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SWERS TO CORRESPONDENTS

en Iris, Vic.) would like to see ortable similar to some commer- vhich the AC power supply does nsformer.

t that these devices offer a num- ages in the matter of space and have always made it a policy ribing such equipment for home While most fellows would prob- ough basic knowledge to handle n of them successfully, there is ne who will do the wrong thing, esults. In the circumstances we e is little likelihood of our de- equipment.

Gibraltar) writes to tell of some of vicing experiences in this part and to comment on some of scribed in R T and H. He also esting circuit of a German port- pply.

hanks for your letter and com- It is certainly interesting to things are done in other places re them with our own efforts. 1956 Little Jim, we did consider mention but investigations showed ere too poor to justify using it ough fellows have enough trouble to get quite ordinary bits and or having IT4's in stock, we of any kind for resale, so we grind there. The .025 Ma series ired in Australia and, from what ear, are not likely to at present. probably be too small to jus- In any case, the performance ro be so far down on the present is doubtful whether they would transistors are more likely to be Most of the equipment built hop is ultimately stripped down t used again. The exceptions are test equipment which we retain se. We are passing your letter eman for possible comments on ers.

ington, NZ): We are a little our reference to the two-stage ber of June, 1955, while the set is issue is a three-stage set. A nsistor set was described in the ue and if this is the set to referring we would suggest that no farther than the July issue ta three-stage set described a you desire to add another stage e set of July, 1955, we can only ahead and try it. A coupling e order you suggest would be

ection to such a high order of dio circuit is the possibility of dit may be necessary to provide upling along the lines of that ly, 1955, circuit.

erton, NZ) submits a number of ding amplifiers, including one lar type of phase changer. ally considered that the type of described provides a less accur- the type we favor, though the l be more academic than prac- tion of power output does not regarding phase changers. You a transistor in the control unit EF86 without extensive altera- not yet ready to describe a unit. A filament centre-tap by means of a 25 or 50 ohm sistor; the exact value is not using your phase changer the should be correct when taken valve driven by the "upper" side sections. In any case, the n always be determined experi-

s Nest, NSW) would like to is possible to use one of the ol Units with an 8-valve radio- with a crystal pickup. trol Unit No. 7 is the most with crystal pickups. Preset not included, since this would as very few crystal pickups ully flat response. Instead, con- bass and treble controls are

feel that you would not derive ugh the addition of a Control ur radiogram is most likely ss and treble control, and this dy prove embarrassing due to

more) would like to know the e feedback resistor in the Play- for use with a 3-ohm voice

t value of feedback resistor for coil is 4500 ohms. The phase or increases inversely with the r, and the value required with a 3-ohm voice coil will be approximately 300 pf. The exact value is usually determined visually by observing the output waveform of the amplifier, while feeding a square wave into the input, or by some other method requiring test instruments, and it is, therefore, not possible to forecast an exact value suitable for all transformers.

K.F. (Mascot, NSW) seeks an explanation as to why the negative side of a power supply is connected to a chassis. K.F. would also like to know if it is possible to connect a pickup to a 5-valve mantel set.

A. We will not answer the first part of your query here, K.F., since we feel that it would be more appropriate for the "Here's Your Answer, Tom" feature. But rest assured you could only receive a shock from the chassis if at the same time you touched the 250 volts positive lead.

A high output crystal pickup may be used with the majority of 5-valve sets. Simply connect the pickup across the volume control. Some provision for killing the signal from the preceding stages must be incorporated. The simplest way is to fit three terminals on the chassis, connecting the top of the volume control to one and a lead from the preceding circuitry to the other. The remaining terminal is an earth terminal. For radio use the two active terminals should be bridged by a piece of wire, while for pickup use the bridge is broken, and the pickup connected between the top of the volume control and earth. Shielded wire should be used for all connections.

R.C.W. (Epping, N.S.W.) sends us a description of how he modified an old type speaker by fitting a home-made high frequency cone to the voice coil. He suggests that the idea may be worth passing on to others.

A.: Many thanks for your contribution, R.C.W., and we will file this for possible use in the Reader Built It section. In the meantime we suggest that materials like thin stiff card might be even better than the leatheroid, and, in fact, there is scope for a lot of experiment along these lines.

C.I.Y. (Bendigo, Vic.) demonstrates his interest in transistors by forwarding a circuit for a complete portable receiver using them. It is a combination of ideas appearing in manufacturers' information and various periodicals, including our own..

A. Frankly, at this stage, we would not be prepared to say definitely whether your circuit could be turned into a practical receiver or not. It may be sufficient comment to say that we have the matter of a transistor receiver well in mind and are prepared to do a good deal of laboratory work before a final design appears in print. The transistors you specify are not generally available at the moment but we are hopeful that they will be in the next few months. The same applies to the IF transformers and some of the other small components.

R.B. (Neutral Bay, NSW) forwards an inquiry concerning a circuit for an AC power supply to suit a loud speaker field coil.

A. We regret that we have no circuits available for an AC power supply to suit a loud speaker field coil. Such a supply would need to deliver about 60 to 80 mA in order to give reasonable excitation. Ideally this should come from a low voltage power transformer in order to avoid the necessity for additional voltage dropping resistor.

Such a transformer is not likely to be available and you will probably have to use a 285 volt type with a 5Y3 rectifier, in a standard rectifier circuit.

This would necessitate the use of a bleed resistor to draw the necessary current from the supply. The value of the resistor could be about 5000 ohms and it should be capable of dissipating about 20 watts of power. The scheme is rather wasteful, but you will probably realise that the field coils of this type were intended to be used in place of a filter choke in the power supply of a conventional receiver or amplifier where such waste is not entailed.

R.W. (Grenfell, N.S.W.) wants to know the meaning of the terms "C.C.S." and "I.C.A.S." ratings as applied to valves. He also suggests that we should describe some 144 Mc gear and a complete transistor set. Finally, he submits an article for the Reader Built It section.

A.: Many thanks for your contribution, R.W., and we will file for possible use as you suggest. The terms "C.C.S." and "I.C.A.S." stand for "Continuous Commercial Service" and "Intermittent Commercial and Amateur Service" respectively. The reasoning behind this is that valves which are operated intermittently can be run at higher ratings than those used continuously. We have in mind to do something in the matter of 144 Mcs gear as soon as possible, but it is difficult to fit in all the things we would like to do in the time available. The transistor set position is not so favourable, suitable transistors being unavailable in any quantities. As soon as the position improves we hope to produce something along the lines you suggest.

G.H.S. (Woollahra, NSW) is interested in transistor portable receivers and wonders if we intend to describe such a receiver in the near future.

A. Rest assured that the matter is not forgotten. However, quite apart from the time

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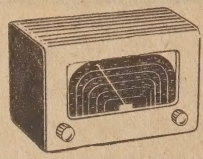

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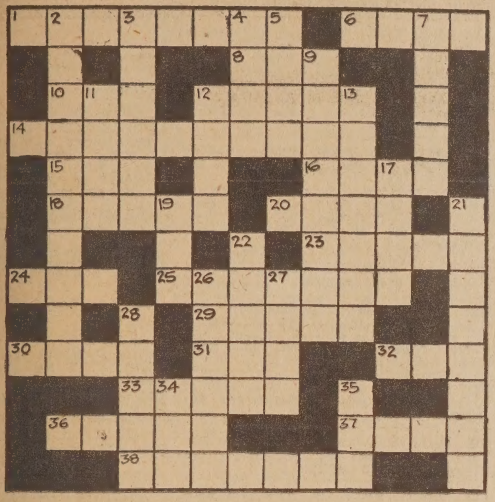

matograph film.
37. One time.
38. Type of square or hysteresis tester.

DOWN

2. Stream of electrons emitted from a cathode. (2 words.)
3. Small in width.
4. Roman Emperor.
5. Amplification.
7. A synthetic fibre.
9. Type of deer.
11. Prefix pertaining to aircraft, aerial locomotion, etc.
12. Adjusting mechanism for tuning controls.
13. Painted representation on the stage.
17. Implement used in rowing
19. Electromotive force (abbrev.).
21. Four element valves.
22. To change.
26. Supplies.
27. To haul.
28. Fearless.
34. Energy, force.
35. Charged atom.

ution and further crossword next month

Last month's solution

E	L	E	C	T	R	O	N	S	■	■	■	O
L	■	A	■	■	I	■	E	■	A	T	O	M
A	I	R	C	H	O	K	E	■	N	■	E	■
S	■	T	U	I	■	I	D	I	O	M	■	G
T	E	H	E	R	A	N	■	■	I	O	T	A
A	■	R	■	E	L	E	M	E	N	T	■	■
N	■	E	■	D	E	T	E	C	T	O	R	S
C	U	T	S	■	■	I	■	U	■	R	■	■
E	M	U	■	A	R	C	H	■	R	■	G	■
■	■	P	R	I	M	E	■	O	R	E	G	O	N
T	I	N	■	P	L	A	T	E	S	■	N	■
■	■	R	■	■	A	■	E	N	E	R	G	Y
M	E	L	O	D	Y	■	L	O	T	■	S	■

Thanks for the subscription, H.P., which we have passed on to the appropriate department, and for the appreciative comments on our journal. We have considered further articles dealing with transistors but, due to pressing editorial matters we have had to shelve the idea for the time being. Likewise, we were unable to prepare an index to volume 16. We hope to rectify this at the earliest available opportunity.

...ction a suitable circuit, there is ...ith high frequency transistors ...cessed in the RF mixer and IF ...enerally available. We regret ...t bare the time to give further de... coils for the transistor receiver ...ith as we would like to do so. ...hanks are appreciated.

...ttle, Qld.) sends his annual sub... takes the opportunity to request ...oretical nature, particularly those ...transistors. He also draws our ...to omission of an index to volume

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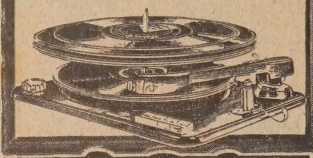

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Cost of Classified advertisements in this section is 3/- per line, approximately five words to a line. Closing date for April issue of Radio, Television and Hobbies is Tuesday, March 5.

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FOR SALE: Dual Player with extra head, £11. No. 7 Control Unit, £7. Both perfect, £16 lot. **H. C. Bosler, 45 Kyogle St., Maroubra.**

FOR SALE: Williamson Amplifier, excellent condition. **Phone WM1997.**

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